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The Philippine Agricultural Review

PUBLISHED BY THE

BUREAU OF AGRICULTURE
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES

MANILA
BUREAU OF PRINTING
1929

(Entered at the Post Office at Manila as second-class matter)

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[Continued on page 3 of Cover]

The Philippine Agricultural Review

[A QUARTERLY PUBLICATION OF THE BUREAU OF AGRICULTURE]

Vol. XXII | SECOND QUARTER, 1929 | No. 2

Subscription rates: ₱2 (Philippine currency) or $1 (U. S. currency) per annum in the Philippine Islands and the United States territories. $2 (U. S. currency) per annum in foreign countries.

Subscriptions should be paid in advance in the form of a post-office money order or draft drawn on a Manila bank in favor of the Bureau of Agriculture, Manila, Philippine Islands.

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RÉSUMÉ OF THE ANNUAL REPORT OF THE BUREAU OF AGRICULTURE FOR THE YEAR ENDING DECEMBER 31, 1928

By STANTON YOUNGBERG
Director of Agriculture

AGRICULTURAL CONDITIONS [1]

Adverse weather during the planting season reduced the hectarage of several crops and, in part, their yield. The reduction in the area might have been overcome by replanting but so many farmers were discouraged by low prices that they did not make the effort they used to make on similar occasions. This was especially true in the case of rice, corn, and tobacco. These three crops suffered a reduction in area and the last two in yield also.

Coconuts, coffee, and cacao commanded good prices and they increased in hectarage and production. Sugar cane increased in total yield and in the yield per hectare, notwithstanding low prices, partly due to improvement in the weather in the latter part of the season and partly to the ever increasing use of fertilizers and better farming practices.

Plant pests and diseases did damage to the extent of one per cent of the combined area of these crops, valued approximately at ₱9,000,000. The year before it was 1.3 per cent, valued at over ₱10,000,000.

Locusts destroyed the crops over one-tenth of one per cent of the combined area, a loss amounting to ₱200,000 as against one-fourth of one per cent, valued approximately at ₱2,000,000 the previous year.

General conditions during the year were on the whole better than for the five-year average before 1926–27, as can be seen in the following table, showing for 1903, and from 1910 to 1928, the combined hectarage of the six leading crops of the Islands, their aggregate value since 1910, and the average value of production per capita, and per hectare.

---

[1] To conform to the crop season of the different products, the crop statistics given everywhere in this report, are, however, for years ending June 30.

Table II shows for 1903, and from 1916 to 1928, the total population of the Islands, the area planted to the leading crops and the area per capita.

TABLE I

Years	Area in hectares	Value	Average value of production per capita	Average value of production per hectare
1903	1,170,100	....	....	....
1910	2,256,530	₱137,005,960	₱15	₱61
1911	2,148,240	152,501,510	17	71
1912	2,303,870	148,347,500	16	64
1913	2,361,480	168,633,730	18	71
1914	2,579,990	163,496,250	17	63
5-year average	2,330,022	153,996,990	17	66
1915	2,622,210	159,055,330	16	63
1916	2,531,700	179,241,380	18	71
1917	2,691,410	244,179,470	24	91
1918	2,918,590	361,940,460	35	124
1919	2,974,920	458,698,580	44	154
5-year average	2,727,766	280,623,040	28	103
1920	3,276,930	687,131,500	65	210
1921	3,515,590	403,258,250	37	115
1922	3,429,750	302,143,710	28	88
1923	3,495,440	380,194,710	34	109
1924	3,516,200	434,754,470	38	124
5-year average	3,446,782	441,496,530	40	128
1925	3,508,140	483,712,230	42	138
1926	3,573,200	478,861,060	41	135
1927	3,669,970	503,666,890	43	137
1928	3,619,430	472,684,580	40	130

TABLE II.—*Area planted in hectares*

Years	Palay	Corn	Sugar cane	Coconut	Abaca	Tobacco	Total
1903	592,766	107,980	71,885	148,245	217,810	31,417	1,170,103
1918	1,368,140	418,390	205,510	335,600	512,510	78,440	2,918,590
1919	1,381,340	430,710	200,200	373,250	515,560	73,860	2,974,920
1920	1,484,890	537,130	197,400	397,030	559,360	101,120	3,276,930
1921	1,673,380	543,830	241,340	417,960	648,090	90,980	3,515,580
1922	1,661,430	549,960	240,820	422,680	494,990	59,870	3,429,750
1923	1,675,870	557,690	227,290	456,440	513,420	64,730	3,495,440
1924	1,737,910	533,230	227,190	460,440	485,340	72,090	3,516,200
1925	1,725,500	522,380	239,470	472,050	477,110	71,630	3,508,140
1926	1,755,920	533,570	231,840	485,030	492,050	74,790	3,573,200
1927	1,807,060	561,430	237,350	500,010	480,150	83,970	3,669,970
1928	1,786,960	518,780	237,000	515,510	480,730	80,480	3,619,430

Number of hectares per capita

Years	Population	Palay	Corn	Sugar cane	Coconuts	Abaca	Tobacco	Total
1903	7,636,426	.0776	.0142	.0094	.0194	.0285	.0041	.1582
1918	10,314,310	.1327	.0406	.0199	.0325	.0497	.0076	.2830
1919	10,398.029	.1328	.0414	.0193	.0359	.0496	.0071	.2861
1920	10,566.040	.1405	.0508	.0187	.0376	.0529	.0096	.3101
1921	10,734,053	.1559	.0507	.0225	.0389	.0510	.0085	.3275
1922	10,902,081	.1524	.0504	.0221	.0388	.0454	.0055	.3146
1923	11,070,306	.1614	.0504	.0205	.0412	.0464	.0058	.3157
1924	11,238,593	.1546	.0475	.0202	.0410	.0432	.0064	.3129
1925	11,406,875	.1513	.0458	.0210	.0414	.0418	.0063	.3075
1926	11,575,176	.1517	.0461	.0200	.0419	.0425	.0065	.3087
1927	11,744,172	.1539	.0478	.0202	.0426	.0409	.0071	.3125
1928	11,913.167	.1500	.0435	.0199	.0433	.0403	.0068	.3038

NOTE.—Slight changes have been made in the figures per capita published in former issues, to conform with the recent estimate on population furnished by the Philippine Health Service.

PALAY (ROUGH RICE)

The heavy rainfalls that culminated in floods due to typhoons during the planting and transplanting seasons destroyed the seedlings and handicapped the field work, reducing by one per cent the hectarage of the preceding season. Weather conditions improved the latter part of the year, however, and offset the loss sustained earlier, so that the total yield was only one-half of one per cent less than the record crop of 1926–27.

The ravages caused by rice pests and diseases were decreased by about two-thirds of one per cent this year being 1.23 per cent as against 1.91 per cent in 1926–27. The money value of the losses was ₱2,300,000 in 1927–28 and ₱3,900,000, the previous year.

The area planted in 1927–28 was 1,786,960 hectares as against 1,807,060 hectares in 1926–27 and the corresponding yields were 49,921,200 and 49,946,400 cavans, of 44 kilos each.

There was a very slight improvement in the yield per hectare. From 27.64 cavans in 1926–27, the general average production increased to 27.94 cavans in 1927–28, the highest average yield per hectare on record.

Due to the large crops gathered in previous years, rice prices declined and the farmers were discouraged, many of them turning to sugar and other more profitable crops.

The average prices per cavan in the three previous years were ₱4.27, ₱4.02, and ₱3.67. The corresponding total values of production were ₱204,051,110, ₱200,970,720, and ₱183,262,570.

Table III shows the area cultivated, production, average yield per hectare, and total value of palay since 1910:

TABLE III

Years	Area cultivated	Production cavans	Average yield per hectare	Total value
1910	1,192,140	18,859,090	15.82	₱55,765,850
1911	1,043,760	20,530,100	19.67	61,759,590
1912	1,078,890	11,622,470	10.77	39,981,290
1913	1,141,240	24,498,860	21.47	57,939,800
1914	1,244,940	22,736,810	18.26	57,261,760
1915	1,130,710	17,818,490	15.76	49,207,980
1916	1,140,830	20,878,860	18.30	65,923,820
1917	1,225,690	28,276,720	23.07	81,377,810
1918	1,368,140	35,795,050	26.16	135,163,370
1919	1,381,340	33,781,650	24.45	188,614,590
1920	1,484,890	36,343,810	24.47	254,855,380
1921	1,673,380	41,478,540	24.79	156,892,680
1922	1,661,430	43,436,830	26.14	139,935,080
1923	1,675,870	43,790,500	26.13	149,475,950
1924	1,737,910	41,570,700	23.92	172,957,290
1925	1,725,500	45,652,600	26.46	192,179,270
1926	1,755,920	47,780,000	27.21	204,051,110
1927	1,807,060	49,946,400	27.64	200,970,720
1928	1,786,960	49,921,200	27.94	183,295,130

SUGAR CANE

The destructive typhoon of November, 1926, and the frequent heavy rains during that month and December, destroyed the young plantations in some provinces and delayed the planting in others. The total area planted in the 1927–28 season was 237,000 hectares, a little less than that of 1926–27, 237,350 hectares.

As weather conditions improved later on and commercial fertilizers were used in liberal amounts, the farmers succeeded in raising a bumper crop of sugar.

The production of all sugars was 11,586,470 piculs, of 63.25 kilos each, as against 10,999,660 piculs the year before, an increase of 5 per cent. The production of sugar for 1927–28 is classified as 9,101,850 piculs centrifugal, 1,850,090 piculs muscovado and 634,530 piculs panochas. Besides this, there were produced 5,440,250 liters of *basi* and 11,203,010 liters of molasses for the year 1927–28 as against 4,066,020 liters of *basi* and 4,365,550 liters of molasses the preceding year. The extraordinarily big increase in molasses should not be considered at all an increase, for in past years most of the mills threw away the molasses as waste and made no report of it. But recently molasses has been used by distilleries and considered as a useful product of sugar cane; hence the apparently extraordinary increase.

During the year prices for sugars declined while those for panochas, *basi* and molasses slightly increased. These were ₱9.77 per picul of sugar, ₱8 per picul of panochas, ₱0.15 per liter of *basi* and ₱0.11 per liter of molasses, while the corresponding prices for the preceding year were ₱10.38, ₱7.65, ₱0.14 and ₱0.10, respectively. The value of all products of sugar cane for the year 1927–28 was ₱114,136,710 as against ₱113,591,090 the year before, an increase of 1 per cent.

COCONUTS

As of June 30, 1928, 515,510 hectares were planted with 98,056,330 trees as against 500,010 hectares with 94,877,740 trees the year before, an increase of 3 per cent in the number of trees planted.

Though weather conditions since November 1926 improved considerably, the destruction done by the typhoon at the time was so great, particularly in the coconut regions, that the yield of the trees has not changed since last year, the average yield per tree remaining the same, 31 nuts.

However, as there were many more trees in bearing during the year 1927–28, 61,068,390 trees, as compared with 58,414,390 trees last year, there were gathered altogether 1,906,804,000 nuts, 106,777,000 nuts more than the harvest in 1926–27.

The copra produced in the year 1927–28 was 6,840,530 piculs, of 63.25 kilos each, and coconut oil (home-made), 1,933,580 liters, as against 6,484,750 piculs of copra and 1,973,710 liters of coconut oil the preceding year. The number of coconuts used for the desiccated coconut industry and for home consumption was 163,211,000 in 1927–28 and 160,276,000 in 1926–27. Besides these, coconut trees produced this year 113,694,610 liters of tuba as against 107,772,910 liters in 1926–27.

Prices for coconut products did not change materially this year. Copra sold at ₱10 per picul; coconut oil (home-made) at ₱0.14 per liter; tuba at ₱0.09 per liter and fresh nuts at ₱4 per hundred. The corresponding prices in 1926–27 were ₱9.95, ₱0.44, ₱0.10, and ₱4.

The total value of all coconut products amounted to ₱85,408,430 in 1927–28 as against ₱81,985,970 in 1926–27, an increase of 4 per cent.

ABACÁ (MANILA HEMP)

Abacá increased by about 600 hectares of new plantings and nearly 100,000 piculs in production and decreased generally in prices.

As of June 30, 1928, 480,730 hectares were planted as against 480,150 the year before and the corresponding areas in production were 394,910 and 381,490 hectares. From these areas were gathered 2,826,340 piculs of fiber, of 63.25 kilos each, during the year and 2,731,630 piculs during the preceding year, an increase of 3 per cent, but the average yield per hectare during both years remained practically the same, 7 piculs.

Abacá during 1927–28 suffered a decrease estimated at nearly ₱5,000,000, a fall of about ₱2.50 in the average price per picul. The total values were ₱54,362,440 in 1927–28 and ₱59,240,800 in 1926–27, and the prices per picul averaged ₱19.23 and ₱21.69, respectively.

CORN

Corn registered among all crops the largest decrease during 1927–28, due to the bumper crop of rice during this year, the low prices for corn the previous season, and adverse weather.

There were 519,680 hectares planted as against 561,430 hectares during 1926–27, a loss of 8 per cent.

The production decreased from 8,384,710 cavans, of 58 kilos each, in 1926–27 to 7,342,300 cavans in 1927–28, a loss of 13 per cent. This crop is the smallest since 1923.

This crop was sold at the average of ₱3.55 per cavan, in 1927–28, and the entire production brought to the farmers ₱26,047,100. The corresponding figures for 1926–27 were ₱4.14 and ₱34,697,470, respectively.

TOBACCO

As for the corn crop, poor weather and declining prices decreased the hectarage and yield of tobacco during the year. There were 80,480 hectares in tobacco which yielded 1,003,840 quintals of leaves of 46 kilos each, while the preceding year the area was 83,970 hectares and the yield, 1,091,660 quintals, a loss of 4 per cent in area and of 8 per cent in production. With the exception of 1926–27, the hectarage and production of 1927–28 were larger than that of any other year since 1921–22.

The total value of the crop amounted to ₱9,334,770 in 1927–28, at an average price of ₱9.30 per quintal. The year before the price averaged ₱12.09 per quintal and the whole crop was worth ₱13,080,830.

MAGUEY

Steadily increasing since 1921, maguey covered on June 30, 1928, 35,630 hectares, 5 per cent over that under cultivation in 1926–27, 34,000 hectares.

During 1927–28, 308,580 piculs of fiber of 63.25 kilos each were produced as against 315,470 piculs the preceding year, a decrease of 2 per cent.

With this decrease in the yield and lower prices, the total value of this fiber decreased from ₱3,838,490 in 1926–27 to ₱3,288,130 in 1927–28, a loss of 14 per cent. The average prices per picul in 1927–28 and 1926–27 were ₱10.67 and ₱12.17, respectively.

CACAO AND COFFEE

In the last five years the highest annual rate of increase was 2 per cent for cacao and 8 per cent for coffee, but, in 1927–28, the increase in the total number of trees was 6 per cent for cacao and 12 per cent for coffee more than that of the preceding year.

On June 30, 1928, there were under cultivation 2,156,800 cacao trees and 2,842,700 coffee trees, as against 2,042,500 and 2,533,700 trees, respectively, the year before. On the same date, too (June 30), there were in bearing 1,244,000 cacao trees and 1,522,000 coffee trees, which yielded 1,172,900 kilos of cacao and 1,236,600 kilos of coffee as against 1,089,100 and 1,209,800, respectively, the preceding year, an increase of nearly 8 and 2 per cent.

Prices for these two products in 1927–28 did not change materially from 1926–27, cacao having sold at ₱0.94 per kilo in 1927–28 and ₱0.92 one year before, while during the same periods coffee prices were ₱0.69 and ₱0.70 per kilo. At these prices the cacao and coffee produced were sold in 1927–28 for ₱1,183,700 and ₱868,600, respectively, as against ₱1,127,600 and ₱840,800 the previous year.

LIVESTOCK

The census for livestock is made as of December 31 of each year. As there is no time to complete the compilation of the data gathered on that date in the short period between the end of the year and the date fixed for presenting this report, the figures given for animals are one year behind.

The year 1927 was generally rainy and on that account the rate of birth of all animals, except horses, was below that for 1926, although the decreases were generally very insignificant. These decreases were .3 per cent for cattle and hogs, .13 per cent for goats, .02 per cent for sheep, and 1.19 per cent for carabaos. The rate of birth for horses increased by .34 per cent.

The situation as to animal diseases improved considerably during 1927, except in the case of horses. There was a reduction of .3 per cent in the rate of mortality for carabaos, of .36 per cent for cattle, of .22 per cent for hogs, of .23 per cent for goats, and of .08 per cent for sheep, while it increased by .44 for horses.

In 1927 there was less consumption of the meat of carabaos, horses, goats and sheep, but a larger consumption of beef and pork than the preceding year. The reduction was 3 per cent in carabao meat, 5 per cent in horse meat, and 7 per cent in goat meat and mutton. Beef and pork consumption increased by 26 and 11 per cent respectively.

ADMINISTRATIVE DIVISION

PERSONNEL

The important appointments made were those of an Entomologist and Acting Chief of a Division and two assistant chiefs of divisions.

At the beginning of the year, there were 270 permanent and 282 temporary employees, in all 552 employees. During the year 112 were appointed and 5 transferred to this Bureau, while 39 resigned, 77 were separated and 3 transferred to other bureaus, making the working force of the Bureau at the end of the year, 277 permanent and 273 temporary employees, a total of 550 employees.

CORRESPONDENCE

There were 314,905 pieces of correspondence handled, 154,410 of which were letters sent and 160,495 letters received. Six thousand one hundred twenty-seven letters were delivered by messengers to different bureaus and offices in the City of Manila. Five hundred eighty-two telegrams were sent out, 1,184 letters received and 914 letters sent by registered mail.

The Bureau spent ₱7,961.28 for postage and ₱798.74 for telegrams.

Transportation service.—This office furnishes the transportation service for the Bureau of Agriculture. It has at present 1 Dodge car for the use of the Director, 2 White trucks for hauling shipments under the direct supervision of the Property Division, 6 carromatas, 1 motorcycle, and 3 carretelas.

Repair service.—Fifty motorcycles and 7 bicycles were overhauled. The Bureau car as well as two White trucks were also given slight repairs from time to time.

ACCOUNTING DIVISION

ACTIVITIES

The handling and the keeping of the accounts of the Tobacco Fund were transferred to this office in June 1927. Another increase in the work that is worth mentioning was in the manner of recording the expenses of the Fiber Work (Act 3263) and those of the Rubber Work (Act 3230). The monthly divisional statements of expenditures were, beginning in January, prepared in such a way as to include as close an estimate as possible of outstanding obligations. Heretofore, the said statements included only accounts actually paid and accounted for in the Central Office and nothing of outstanding obligations.

The total expenditures of the Bureau for 1928 were ₱1,430,000.48 while those for 1927 were ₱1,339,733.99, an increase of ₱90,266.49. The total income for 1928 was ₱192,500.33 as against ₱224,717.38 for 1927, a decrease of ₱32,217.05. The total net cost, therefore, of running the Bureau for 1928 was ₱1,237,000.15 as against ₱1,115,016.61 for 1927, an increase of ₱122,483.54.

The per capita expenditures of the Bureau in 1903 and in 1918–1928, had the income realized thereby been available for expenditures, would have been: for 1903, ₱0.023; 1918, ₱0.08; 1919, ₱0.11407; 1920, ₱0.1509; 1921, ₱0.1388; 1922, ₱0.1079; 1923, ₱0.0834; 1924, ₱0.1008; 1925, ₱0.0883; 1926, ₱0.0971; 1927, ₱0.0949; and 1928, ₱0.1039.

PROPERTY DIVISION

CONSTRUCTION

This was a banner year for construction for the Bureau of Agriculture. A permanent museum has been constructed where the Bureau's products in the experiment stations, laboratory and stock farms can be exhibited for the benefit of the general public. Divisional partitions have likewise been set up giving each office the privacy it needs.

A hangar, strong and large enough to house our four aëroplanes, was constructed on the Government land in Camp Claudio, Parañaque, Rizal.

Two greenhouses, one for the Pests Control Division at Singalong and another for the Division of Plant Investigations at the Alabang Rice Experiment Station, were bult.

The laboratory provided for by an Act of the Legislature for the manufacture of anti-rinderpest serum and vaccine was likewise started during the middle part of the year at Pandacan.

REPAIRS TO BUREAU BUILDINGS

The extensive alteration to the Central Office to provide a better office for the Director, the transfer of the Administrative and Accounting Divisions to the south wing of the old Philippine Library and Museum, the allotment of more office space to the different divisions left in the main building, the construction of a second story over the Plant Investigations and Pests Control Divisions for the fiber and soil laboratory, the alterations made in the storeroom and the repairs at the Sisiman Matadero exhausted our repair funds for the year.

PROPERTY ACQUISITIONS

Among the property purchases worth mentioning were the Welsh pony ordered from Australia to improve our draft horses; instruments and apparatus for the fiber, veterinary and locust laboratories; pumps for spraying purposes in connection with locust control work and for the disinfection of insect infested plants; agricultural implements to replace those which have become unserviceable in our stock farms, demonstration and experiment stations; scientific books for our reference work in the study, control and researches on animal and plant pests and diseases and agricultural experimentation; and a motor launch for the use of the Sarunayan Tobacco Experiment Station in Cotabato.

Of the supplies acquired during the year special mention may be made of the 60,000 doses of anti-anthrax serum and vaccine, the chemicals for the extermination of rice worms and other insect pests and the fertilizers for crop experiments.

A shipment of livestock from the United States consisting of American pure bred chickens, pigeons, turkeys, ducks, geese, hogs, goats, and sheep, was received in January and added to the old stocks at Alabang.

The shipments handled by the division, foreign and insular, follow:

Shipments cleared and received

	Number of shipments	Number of cases	Weight	Value
			Kilos	
Outgoing	1,748	6,588	180,899	₱118,864.16
Incoming	587	5,964	167,879	38,533.77
Total for fiscal year 1928	2,335	12,552	348,778	157,397.93
Total for fiscal year 1927	2,930	12,674	388,069	188,863.08
Increase or decrease	—595	—122	—39,291	—31,465 15

Shipments handled by our trucks for the Singalong Demonstration and Propagation Station, the Pandacan Research Laboratory, and the Plant Quarantine Office are not included in the above table.

Work done during the year

Items	1928	1927	Increase + or Decrease —
Requisitions for equipment and supplies (Bureaus of Supply and Printing)	707	362	+ 345
Direct orders (contract payments)	222	249	— 27
Work and repair orders	226	145	+ 81
Requests for supplies and equipment	5,749	4,546	+1,203
Issue vouchers	6,500	6,174	+ 326
Memorandum and invoice-receipts	856	....	....
Report and supplies issues	55	....	....
Bills checked, verified, audited	600	....	....
Descriptive lists prepared	250	....	....
Death certificates-autopsy reported cleared	800	....	....

FIXED ASSETS

The total value of the fixed assets of the Bureau for 1928 was ₱1,387,086.85, while the value of those for 1927 was ₱1,281,968.92, an increase of ₱105,118.03.

DIVISION OF PLANT INVESTIGATIONS

ADMINISTRATION

This division consists of agronomy, fiber and horticulture sections and 15 agricultural investigational districts covering the Philippines and has a total of 39 permanent and 10 temporary employees. Its crop activities remain the same as in previous years. Three bulletins, two circulars and a number of articles and press notes were prepared by the division during the year.

AGRONOMY SECTION

Lowland rice.—Of 35 foreign varieties, acclimatized at the Rosales (Pangasinan) Rice Experiment Station, the three best were the Tadung, Pahit Strain No. 7 and Tor Dung Bap, Macan Biñan, 40.0 cavans. Binambang II, 40.1, Phung Tiiy, 43.4, Elonelon, 45.2 and Ramai, 50.7 cavans were the best yielders out of the 18 varieties tested in the variety test plot. The Guinangang Strain No. 1 yielded 72.7 against Mangasa Tanza producing 21.1 cavans only per hectare when planted during the dry season (palagad).

The best combination of N–P–K found in Rosales station, using the Apostol variety in a single plot test, was 50–25–25 per cent, giving 97 against 61 cavans to the hectare of the control.

Planting mongo as green manure in Alabang, Rizal, raised the yield of the Inadhica variety 18.5 cavans over that of the control and in Rosales, the cowpeas increased the yield of the Sipot variety 20.4 cavans to the hectare over the control plots.

Using the Inachupal I variety, the yield of the surface soil was more than that of the subsoil. Khao Bai Sri transplanted 2 days after lifting produced 55.2; 4 days after, 28.2; and 6 days after 23.3 cavans per hectare. Using the Inadhica variety, the mean difference in favor of the erect over the inclined (45°) seedlings was 7.8–2.8. Using the Ramai and Mancasar strain No. 3 the average gain by pruned seedlings over the unpruned was 12.5 per cent.

In the pedigree work the Guinangang strain No. 1 yielded 41.2 cavans per hectare, gaining 43 per cent over the original variety; and Mancasar strain No. 3, 43.4 cavans, gaining 5.6 per cent over the original stock. This strain had a 30 per cent increase in yield last year.

Upland rice.—Of the 80 varieties tested, the Kinamantigue, Kinamyas, Binolagsak, Inintiw, Mita M, and Panay produced the most, yielding from 40.5 to 59.0 cavans per hectare.

Corn.—Of the 26 varieties tested, the Calamba Yellow, Cagayan Yellow, Baluga Yellow, and Moro White gave the highest yield, 17.63 to 20.57 cavans of shelled corn per hectare. In shelling quality, however, the Tinigbi, Siam-siam, Cebu, Ferguson Yellow and Calipus corns, were the highest. Among the pop corn varieties, the Rice variety produced the largest yield per hectare, besides having the highest popping quality.

Green manuring with cowpeas increased the yield of corn ears to 32 per cent.

Sugar cane.—Among 50 varieties, the highest in apparent purity of sucrose content were the Mindoro, L. C. 24/27, and Hambledon–5. In the variety test the L. C. 22/4 gave the highest yield of sugar per hectare; and the Inalmon White, the lowest.

The plots planted to Badila cane and fertilized with 4 commercial and 4 home-mixed fertilizers, gained from 7.5 to 16.5 piculs of sugar per hectare over the untreated plot. Mixture E. 20 per cent N, 21.22 per cent P_2O_5 and 48 per cent K_2O gave the highest yield of sugar per hectare. In another fertilizer test using Badila cane, the results obtained were as follows: Control, 107.23 piculs; 250 ammonium sulphate with 500 kilos of lime, 127.30 piculs; 250 ammonium sulphate without lime, 140.37 piculs; and 1 ton of 10–6–2 fertilizer without lime, 149.25 piculs of sugar per hectare.

Of all the crosses made, the most promising was the Java-247 by Badila.

During the year 239 analyses of sugar cane juices were made for the station and for the farmers.

Tobacco.—Thirty-six foreign varieties were tested this year and those that appeared promising are to be subjected to a rigid selection test. In the variety test of wrapper tobacco, the 43-(8293) Philippine Sumatra, 18-(8714) Philippine Florida Sumatra, and 65-(9610) Havanensis, were the highest yielders per hectare. At Ilagan, Isabela, and at Sarunayan, Cotabato, the 14-Philippine Sumatra was the best among the varieties tested. The 3 best fillers this year were: 6-(8735) Pampano No. 2, 10-(8737) Repollo, and 12-(8739) Pampano No. 1. Of the fillers, the 52-(8731) Vizcaya, 11-(8738) Espada, and 15-(8741) Romero (aromatic), were the best.

The wild patani stems were the best mulching material found at Ilagan, and at Sarunayan, the *talahib* (*Saccharum spontaneum*). Using the 24-Philippine Sumatra variety, there was a gain of over 98 per cent in the yield of leaf tobacco in favor of the bed method of culture, with 22.47 per cent wrapper for the bed and 8.42 per cent for the ridge system. A preliminary test showed that the optimum water requirement for tobacco was 60 per cent soil mixture. The 36-to-an-inch mesh cheese cloth used for shade produced more wrapper tobacco than the bamboo slats set an inch or 3 inches apart and the *talahib* shades. The pricked seedlings, when carefully pulled up with earth, set in 40 by 90 centimeter holes and ridged up by cultivator, produced more wrapper and less cured leaf tobacco per hectare than the unpricked seedlings. Those with earth and unbroken roots, planted in furrows, yielded 1,041.65 kilos of leaf with 29.14 per cent wrapper; and those without, 1,571.03 kilos with 13.8 per cent wrapper. Cultivated with a plow, there was a yield of 1,446.76 kilos of leaf tobacco with 38.13 per cent wrapper; and with a cultivator, 1,571.03 kilos with 13.8 per cent wrapper.

Forage crops.—Napier, Merker, Guinea, Balili, Barit, Para and Bungalon grasses have been found promising as soiling crops. The Kikuyu grass, a recent introduction, has proved successful in the Mountain Province. The Natal grass thrives in the lowlands. As pasture grasses, the Kikuyu and Dallis are well adapted to high altitudes, while the Bermuda and the Carabao thrive at low elevations.

Miscellaneous agronomy.—Of certain wild legumes tried, *mani-manihan* proved to be the most promising and of the cultivated legumes, the *Crotalaria juncea* ranked the highest, yielding 3.5 kilos of green manure and 0.57 kilos of dry matter, per square meter.

Green manuring.—Mongo broadcasted on unplowed ground and then harrowed in, produced 5,900 kilos of green matter and 8.3 cavans of seed. Cowpeas, planted in furrows, yielded 12,740 kilos of green matter and 13.0 cavans of seed per hectare.

Abacá.—The best fertilizer tried on eleven varieties of abacá as regards their resistance to the bunchy-top disease, is ammonium sulphate followed by a complete fertilizer having a formula of 10–6–2.

The most productive varieties of abacá are the Lausigon, Samina, Inisarog, Bulao, and Maguindanao.

As to the preparation of the abacá field, an uncleared and unplowed field of abacá in Albay produced the highest amount of fiber (1928).

Abacá fiber produced from an open plantation is much stronger than that from a shaded plantation, the difference being 2,279 grams per gram meter in favor of fiber from open plantation.

In Albay, an abacá plot cleared once every four months with bolo and sickle gave the highest yield per hectare, at a total

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ANIMAL INDUSTRY DIVISION

VETERINARY SECTION

ADMINISTRATION

Importation from foreign ports.—During the year there arrived at the port of Manila, 7,907 cattle from Australia and 40 from the United States. No carabaos were imported during the year. This marks a decrease of 2,760 head of cattle as compared with 1927.

Interisland shipments.—There arrived at Manila from interisland ports 16,483 cattle and 2,645 carabaos, an increase of 745 cattle and 30 carabaos over the previous year.

Inspections for which fees were collected.—A total of 156,648 animals of all kinds were inspected upon arrival at Manila, for which fees amounting to ₱20,281.30 were charged and collected. Of these animals 126,813 were swine.

Post-mortem inspections in Azcarraga Matadero.—There were 140,808 animals of all kinds inspected, of which 138,901 were passed for food and 1,905 condemned. The number inspected includes 122,717 swine.

Post-mortem inspection in Pandacan Matadero.—Only 167 animals were slaughtered at this matadero, none of which were condemned.

Post-mortem inspection in Sisiman Matadero.—At Sisiman 9,237 Australian cattle were slaughtered, of which 185 were condemned and 8,052 passed for food.

COMBATING OF ANIMAL DISEASES

Rinderpest.—During the year 3,650 cases of rinderpest were reported with 2,692 deaths, which constitutes an increase of 637 cases and 569 deaths over the previous year, but is far below the average in the past 15 years. The provinces in which the disease was present during some part of the year are Abra, Antique, Cagayan, Ilocos Sur, Iloilo, Isabela, Mountain, Occidental Negros, Pampanga, and Tarlac.

At the beginning of the year there were 7 infected municipalities in 5 provinces and on December 31, 1928, 13 infected towns in 6 provinces. There were 67 outbreaks of rinderpest, counting each time a municipality is infected or reinfected as a separate outbreak.

The following table gives the number of rinderpest cases and deaths by three-month periods during 1928:

Rinderpest cases and deaths by quarters

Period	New cases	Deaths
First quarter	754	509
Second quarter	1,368	1,029
Third quarter	1,113	815
Fourth quarter	415	339
Total	3,650	2,692

Anthrax.—Sporadic cases of anthrax were reported during the year in Batangas, Bulacan, Cavite, Laguna, Nueva Ecija, Pampanga, Pangasinan, Rizal, and Tarlac, totalling 313 cases and 287 deaths, representing a reduction of 9 cases and 14 deaths from those of the previous year. Sixty two thousand four hundred eighty carabaos and cattle were given simultaneous treatment with anthrax vaccine and anti-anthrax serum as compared with 48,677 carabaos and cattle during the preceding year.

Hemorrhagic septicemia.—Outbreaks of this disease occurred during the year in Bohol, Bulacan, Camarines Sur, Cebu, Laguna, Leyte, Mountain, Nueva Vizcaya, Occidental Negros, Samar, and Tayabas. Four hundred four cases and 341 deaths were recorded against 596 cases and 532 deaths during the previous year. Of the 404 cases, only 8 were cattle, the rest being carabaos. A total of 1,423 animals were given hemorrhagic septicemia aggressin. The important outbreaks occurred in Samar, Camarines Sur and Bohol.

Rabies in cattle.—During the latter part of May an outbreak of rabies was discovered by this Bureau in a herd of 130 cattle in the Province of Tarlac. Four of the heads from the animals that died of the disease were examined microscopically by the Veterinary Research Laboratory in Manila, and in all of them Negri bodies were found.

Anti-rabies vaccination proved effective and prevented death. This is the first time that rabies has been reported in cattle in the Philippines. The disease has been reported in horses, however, on three different occasions.

Surra.—Cases of this disease were discovered during the year in Bulacan, Cagayan, Capiz, Isabela, La Union, Masbate, Nueva Vizcaya, Occidental Negros, Pangasinan, and Tarlac. There were reported 268 cases in all, including carabaos, cattle and horses.

Foot-and-mouth disease.—There were fewer outbreaks of this disease reported last year during this year, it having been stopped from moving farther north than Tarlac. The provinces registering cases were Bataan, Bulacan, Iloilo, Laguna, Manila, Occidental Negros, Oriental Negros, Pampanga, Rizal, Tarlac, and Tayabas. The total cases and deaths were 3,749 and 90, respectively, as compared with 24,232 cases and 375 deaths reported last year.

Glanders.—One case of glanders in Sorsogon and two in Tarlac were reported.

Bovine contagious pleuropneumonia.—Chronic cases of this disease were encountered at the Sisiman slaughterhouse among imported Australian cattle at the post-mortem examination in the course of the meat inspection.

Tuberculosis.—As with pleuropneumonia, cases of tuberculosis were found among the Australian cattle in the course of the meat inspection at the Sisiman slaughterhouse.

Goose septicemia.—In the early part of December a steamship arrived in the port of Manila with a crate containing 18 geese from China. The ship's manifest indicated that 30 geese had been shipped. On inquiry, it was discovered that 12 geese had died in transit. The remaining 18 geese were landed and placed in quarantine, and during the night six of them died.

On microscopical examination made at the Veterinary Research Laboratory, a diagnosis of goose septicemia was made.

Unfortunately section 1761 of the Administrative Code which defines the term "domestic animals" does not include fowls and therefore the importation of geese and chickens from Chinese ports can not be prohibited. The landing of such animals under quarantine restrictions is not a safe practice for the reason that isolation and quarantine facilities are wholly inadequate and, even under the most favorable conditions, the practice is a dangerous one from every standpoint.

VETERINARY RESEARCH LABORATORY

Rinderpest vaccine.—In the preparation of rinderpest vaccine, 644 cattle and 11 carabaos valued at ₱41,683 were used during the year. For the potency tests, 80 cattle and 9 carabaos costing ₱6,126 were used. For preparing special experimental lots of vaccine and the experimentation with these lots, 140 animals valued at ₱9,454 were used.

During the year, 1,507,097 cubic centimeters of vaccine was manufactured. From January to May, inclusive, 102,053 animals were vaccinated by the three-injection method. During the year, 31,306 cattle and 57,908 carabaos were vaccinated by the single-injection method, making a total of 116,712 vaccinated by both methods, a total of ₱249,893 cattle doses. We have now standardized our vaccine on the basis of the single-injection method using a cattle dose of 3 cubic centimeters. Carabaos, being more highly susceptible, are given double this amount. The largest amounts of vaccine were used in Antique, 44,911; Cagayan, 35,597; Iloilo, 35,880; Ilocos Sur, 55,433; and Isabela, 32,236 cattle doses.

Anti-rinderpest serum.—The practice of simultaneously immunizing animals with anti-rinderpest serum and virus has been discontinued because of the success attained in immunizing with vaccine, followed by virus, which method is far cheaper. The year's output amounted to 16,320 cubic centimeters, valued at ₱261.

Abortion.—During the year, 2 cases of abortion in swine were diagnosed by this laboratory. Both specimens came from Alabang.

Anthrax.—The five specimens submitted to the laboratory came from Dagupan, San Aurelio, Balungao, Pangasinan; Canlubang, Laguna and San Miguel, Tarlac. One anthrax suspect from Tarlac and 1 from Bulacan Province proved negative.

Fowl cholera.—Specimens received from Vigan, Bontoc, La Loma, Santa Ana and Sampaloc proved to be positive. An outbreak of this disease also occurred in Pandacan, Manila.

Goose septicemia.—This was positively diagnosed in a flock on the Alabang Stock Farm and also in imported birds from Hongkong, examined in Manila.

Hemorrhagic septicemia.—One positive specimen of this disease was received from Secante, Cebu, and another, at Pandacan, Manila.

Malignant edema.—Two carabao specimens from Catubig, 1 from Basey, Samar, 1 hog from Alabang and 1 cow in Manila, were positive.

Hog cholera.—The outbreak of this disease was positively diagnosed from specimens brought to this laboratory from the Alabang Stock Farm.

Coccidiosis.—Many cases of this disease were positively diagnosed in carabaos and cattle brought to this laboratory at various times throughout the year. Vaccine animals from Davao, Palawan, and Dalupiri were shown to harbor this infection.

Villafranca lemon tree, 3 years old. Tanauan Citrus Experiment Station, Tanauan, Batangas

Surra.—Two cases among carabaos and 1 case in cattle were positively diagnosed at this laboratory. One horse in Aguilar (Pangasinan) and 1 carabao in Tarlac were found affected with this disease.

Distomatosis.—Liver fluke infestation was seen in a Palaui carabao and 1 case in a vaca used for vaccine production; both cases diagnosed on post-mortem examination.

Epizoötic lymphangitis.—One carromata horse in Manila was positively diagnosed, *Cryptococcus farciminosus* being demonstrated in smears prepared from lesions.

Anaplasmosis.—Several specimens sent from Tarlac for anaplasmosis examination proved negative. These specimens were taken from cattle, as were also specimens of a tick with which they were heavily infested. The tick proved to be one which is not a carrier of either piroplasma or anaplasma.

Actinomycosis.—Two specimens were received from Sisiman. One specimen was found positive. The other did not reveal the presence of the ray fungus, *Actinomyces bovis.*

Strongylosis.—Three goats autopsied at Pandacan were heavily infested by the larvæ of *Esophagostonum columbianum* (nodular strongylosis). One of these goats was also found to harbor *Hæmonchus contortus* in large numbers.

Cysticercosis.—Measles was identified in a specimen brought to the laboratory from Malabon, Rizal.

Avian diphtheria, roup, and chicken pox.—Three outbreaks of this group of fowl disease in Manila were diagnosed.

Avian pest.—The new fowl disease tentatively named "avian pest," so destructive in and around the City of Manila last year has been mild this year. This disease was diagnosed in the districts of Pandacan, Sampaloc and Singalong, Manila, and Caloocan and San Francisco del Monte, Rizal.

Papillomata.—One case was observed in a herd of Mindoro cattle brought to the laboratory for vaccine manufacture.

Bumblefoot.—Two cases of simple bumblefoot were diagnosed in a fowl taken from a flock in Manila.

Rabies.—Sixty (60) brain specimens were examined: 53 dogs, 4 cattle, 2 rabbits and 1 monkey. The largest numbers of specimens were sent in March, 12, and in December, 11. Of the dogs, 14 were positive, 34 negative, and 5 doubtful.

New biologic products.—Seven hundred doses of chicken pox vaccine were manufactured and are now on hand.

Two thousand two hundred fifty cubic centimeters of hog cholera virus were made at the laboratory. Hog cholera virus, which is used in conjunction with anti-hog cholera serum in immunizing swine against hog cholera, is continually kept on hand at the laboratory. This virus, when used with hog cholera serum (which may be purchased from manufacturers in the United States), immunizes an animal against this most deadly disease of swine.

One hundred twenty cubic centimeters of autogenous bacterin were prepared for a local veterinarian.

Forage and forage crops.—All the green feed consumed during the year was grown in the laboratory fields and in those of the Pandacan Quarantine Station. The forage value is estimated at ₱6,809.16. Mixed feed, valued at ₱379.80, was received from the Alabang Stock Farm. The straw and concentrates used were purchased at ₱1,494.46.

Small animals.—This year, rabbits were raised successfully and in sufficient numbers to serve the Bureau's needs. White rats, sometimes used for laboratory diagnosis, have also been successfully bred.

Improvements in building and equipment—Advances in sterility of manufacture—Economies effected.—Marked improvements along these lines were made during the year. A new especially designed operating table has been constructed by a local firm, tested and found to be very satisfactory.

A new strainer, used in vaccine manufacture, designed on the same principle as embroidery hoops, has proved to be another excellent improvement.

A simple power device, eliminating hand shaking of the vaccine after the addition of chloroform, was put into operation on March 17 and proved satisfactory.

An apparatus of the most approved type, especially designed to meet our requirements for filling vaccine into final containers, was put into use on October 1st.

The most important improvement and economy effected this year was brought about by the adoption for vaccine final containers of bottles stoppered with a puncturable rubber stopper. This change not only saved much labor in diluting the vaccine, but also made it possible to dispense with vaccine diluting stations, which resulted in a very considerable saving. A new sealing composition for rubber stoppers for final vaccine containers has proved to be efficient in preventing contamination from gaining access to the vaccine. An improved method of packing rinsing fluid has been adopted. The stoppers are covered with wax paper and the bottles are placed in cartons of corrugated strawboard. These bottles are then packed in boxes of suitable size for shipment.

Economy in labor and feeding expense was effected by disposing of all animals which had served their purpose. The revenue derived from this source amounted to ₱4,906.18 for the year. Equipment with a book value of ₱4,665.09 is now available for transfer.

Changes in the manufacture and administration of rinderpest vaccine.—On January 10, 1928 the original Boynton vaccine method of manufacture and administration was discontinued and henceforth rinderpest vaccine was manufactured by the chloroform-treatment method worked out by Major R. A. Kelser and the Bureau of Agriculture collaborating, using the three-injection method. In view of the saving of two-thirds of the expense, time and animal flesh if a single injection method could be evolved, the Veterinary Research Laboratory concentrated its efforts toward that end and succeeded by the elimination of all tissues except those of highest potency.

Reports from the field indicate that the new vaccine as now manufactured is as efficient in single injections as the old in 3 injections. For the period from January 1 to June 30, 1928, the unit cost of the new vaccine, based upon the cost of animals alone, was ₱0.17 per vaccination, single injection, as compared to an average of ₱0.52 per vaccination in the 3 to 6 injections of the Boynton method.

ILOILO ANIMAL QUARANTINE STATION

In Panay and Negros the laboratory shed, in previous years served as the rinderpest vaccine substation. Minor repairs were made on the laboratory shed, but the animal sheds are still out of repair as they were during the last typhoon. Extensive repairs will be necessary to make them a fit shelter for animals.

SISIMAN MATADERO

The pier of the slaughterhouse was repaired during the year by the Bureau of Public Works.

ANIMAL HUSBANDRY SECTION

ADMINISTRATION

The live stock imported during the year were as follows: for the Trinidad Farm School and private parties (from Australia)—2 Devon bulls, 9 Angus bulls, I Angus cow, and 17 Ayrshire cows; for the Bureau of Agriculture (from U. S.)—2 Shropshire sheep, 3 Anglo-Nubian goats, 3 Duroc-Jersey pigs, 4 Poland-China pigs, 7 Berkshire pigs, 6 Bronze turkeys, 6 Toulouse geese, 7 Muscovy ducks, 6 Indian Runner ducks, 12 White King pigeons and 135 chickens and 37 rabbits (from Shanghai).

The public breeding work in 1928 as compared with previous years was as follows:

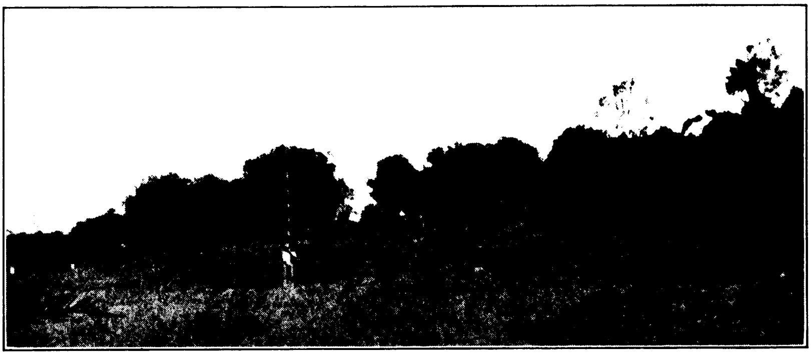
Sires	Services	Offspring	Estimated value
Stallions:			
1926	413	74	₱3,700.00
1927	547	127	12,700.00
1928	509	125	12,500.00
Bulls:			
1926	751	287	14,450.00
1927	37	311	15,800.00
1928	708	341	17,010.00
Boars:			
1926	820	1,431	14,310.00
1927	935	1,838	27,570.00
1928	852	2,572	38,580.00
Bucks:			
1926	185	85	170.00
1927	23	25	125.00
1928	59	22	110.00
Rams:			
1926	55	5	10.00
1927	4	4	20.00
1928	80	53	265.00

ALABANG STOCK FARM

The crossing of Ayrshire bulls with Indian and grade Ayrshire cows in an endeavor to produce a milch type adapted to thrive under local conditions, was started in 1921 and bids fair to succeed, especially if more pecuniary aid is accorded to this project. The animals of this dairy herd consist at this time of several head of mestizo Ayrshire-Indian cows, some of which are already producing as much as seven liters of milk per day, which is considered a fairly good record, in view of the fact that it is their first milking and that they come of dams whose milk production averages less than a liter per day.

HORSES

This project is in fair condition only as there is no stallion that may be used at present for breeding. There are, however, 4 young colts that are very promising. Two were sired by Dick, the Arabian stallion, and two by the Welsh pony. These colts are being ridden daily to accustom them to the saddle and are now very tame. One of them has already attracted some attention from the race track men and offers were made to buy him. The fillies produced on this farm from the crosses with the Welsh and Arab stallions look to be of better confor-



(*a*) A portion of the mango plantation in the Lamao Experiment Station, Lamao, Bataan. The trees were planted in cleared but unplowed land

(*b*) A portion of the mango plantation in the Lamao Experiment Station. The trees were planted in land kept well plowed

mation on the average than the male colts. They can be bred to the Arab stallions that will be imported next year.

CATTLE

There were eight three-fourths Ayrshire-Indians produced, one one half-Ayrshire-Indian and one one half-Ayrshire-Native. Of the two Sussex bulls transferred to La Carlota one sired one calf from a Fuga cow and the other served an Indian cow, which may soon drop a calf.

SHEEP AND GOATS

Although there were some deaths during the rainy weather among the goats and sheep the projects were in a satisfactory condition at the end of the year. Among the goats were 51 births and among the sheep, 19. From sales and transfers alone, the station realized ₱325 from these projects.

SWINE

This year saw a new plan in the raising of pigs. Newly farrowed sows are now placed in portable houses and set on a new range. From what has been observed this plan will bring better results as the young pigs grow faster and more healthy.

MISCELLANEOUS—SMALL ANIMALS

A new introduction on the farm are the rabbits. In a short time, from a few head, they have multiplied to over 100. Those that originated from Manila stock have multiplied well and are healthier and bigger. Those imported from Shanghai were small and sickly. The raising of these animals was mainly for the purpose of filling the big demand for them as the local production was too small even for the few laboratories in Manila.

POULTRY

Of the breeds of poultry imported from the United States and raised on this farm, the Rhode Island Red and the Buff Leghorn chickens, the Toulouse geese, the Indian Runner ducks, and the Homer and King pigeons are best suited to local conditions. The White Leghorn, Buff Cochin, Buff Orpington, Barred Plymouth Rock and Light Brahma chickens, the Muscovy ducks, the Bronze turkeys, and the Embden geese are harder to raise. The Black Minorca, Buttercup, Ancona, Pyle, Silver Wyandotte, White Plymouth Rock, Black Orpington, and Dark Cornish chickens have failed to multiply.

Strange as it may seem, the temperature of incubators, if regulated according to directions of the manufacturers, hastens the hatching of chickens' eggs to 19 days during the dry season, but the chicks from them do not appear healthy and many die. When this temperature is changed to from 100° to 101° F. for the first week, 101° to 102° F. for the second week, and 103° to 104° F. during the third week and the floor of the incubator cellar is wet and moist sand put in a tray inside the incubator, the hatch becomes normal.

EXPERIMENTS

Ratiles (Muntingia calabura L.) *berries as feed for growing pigs.*—This test made of "ratiles" berries shows that pigs eating them will consume less of the regular feed and still gain slightly more weight than when fed only the regular feed for pigs.

The kamala treatment for worms of chickens.—This treatment was tried at Alabang and was found very efficacious for tape worms and, to some extent, for round worms. When mixed with the mash feed, the chickens ate it readily. Contrary to results obtained elsewhere, the egg production decreased in all the poultry pens where it was tried. Its present cost is ₱16.80 per kilogram and the cost per head for mature birds is ₱0.0455.

Capon production.—The feeding of Cantonese cockerels after the age of 6 months has proved to be a steady loss, as the cost of feed is higher than the gain in flesh. In this test, Cantonese capons gave the highest monthly gain in weight over the mestizo White Leghorn and mestizo Brown Leghorn capons.

Comparison of results from hatching at different seasons.—In a test at the Alabang Stock Farm it was found that the highest per cent of fertility and hatch is obtained from August to January; that the temperature of the incubator cellar has a direct relation to the percentage of hatch and that a low temperature in the cellar favors a higher percentage of hatch.

LA CARLOTA EXPERIMENT STATION

There are two Sussex bulls and several hundred Indian and grade cattle. There is a small herd of carabaos, some poultry, some sheep and a few head of swine.

Crossing was started this year between the Sussex and the Indian grade cattle for meat production. For this purpose, the two Sussex bulls newly imported were used.

The cross of the White Leghorn with white native chickens and grade White Leghorns is producing very satisfactory offspring. This work will be reported on when the experiment is completed.

CEBU BREEDING STATION

The Cebu Breeding Station controls the public breeding bulls for Cebu and Oriental Negros and it raises poultry and swine but lacks stock to fill the big local demand for them.

The station at Larena, subprovince of Siquijor, had to be closed early during the second quarter for lack of funds. This station was run coöperatively with the subprovince of Siquijor.

BAYOMBONG CATTLE BREEDING STATION

This station, devoted to the raising of pure Indian cattle, is supported with the help of the Bureau of Non-Christian Tribes. All bulls raised on this farm that are fit for breeding are either sold or used for public breeding in private herds. At present there are 10 such bulls in the field, 9 in Nueva Vizcaya and one in the subprovince of Ifugao. They are reported to be among 302 cows and to have produced 72 grade offspring.

BATANGAS BREEDING STATION

This station is the most important station as regards the breeding of horses. Foals produced by this station have been sold for from ₱500 to ₱1,000 each. Usually every year several hundred young are produced, but this year only 106 foals were reported. These valued at only ₱100 each would be worth ₱10,600.

The young pigs sired by the public breeding boars of this station totaled 256, which, if sold at ₱15 each, would be valued at ₱3,840.

COÖPERATIVE STATIONS

There are a number of coöperative stations to which this Bureau loans pigs and chickens for breeding and for production. These stations are under different Government entities as follows:

Bureau of Education:
  1. Bukidnon Agricultural School, Bukidnon, Mindanao.
  2. San Carlos Farm School, San Carlos, Pangasinan.

Bureau of Prisons:
  1. Iwahig Penal Colony, Palawan.

Provincial Governments:
  1. Santa Barbara Poultry-Swine Station, Sta. Barbara, Pangasinan.
  2. Larena Poultry-Swine Station, Siquijor, (closed during the year).
  3. Dumaguete Poultry-Swine Station, Dumaguete, Oriental Negros.

These stations are under the supervision of this Bureau and the men in charge are required to submit quarterly and annual reports.

DIVISION OF PUBLICATIONS

WORK DURING THE YEAR

During the year there were published 1 annual report, 4 issues of the Philippine Agricultural Review, 4 issues of *Ang Magsasakang Pilipino,* 6 bulletins, 2 new circulars, 9 old ones, 1 Miscellaneous Agricultural Information, 2 series of radio lectures, 6 miscellaneous publications and 4 posters. During the same period 205,392 of these publications were distributed as against 201,909 in 1927, an increase of 3,483 publications.

THE PHILIPPINE AGRICULTURAL REVIEW

During the year, four issues of the Review and a supplement dedicated to the memory of the late Honorable Silverio Apostol, Acting Secretary of Agriculture and Natural Resources, were published.

A total of 4,192 issues were distributed.

"ANG MAGSASAKANG PILIPINO"

The plan to publish the Philippine Farmer in the Visayan, Ilocano and other important Filipino dialects could not be carried out in 1928 due to our inability to secure additional appropriation, so it was published only in Tagalog in four issues. There is a growing demand for this journal in Tagalog-speaking provinces, 15,010 copies being sent out.

BULLETINS

More bulletins were prepared in 1928 than in any other year, numbering six. Only one bulletin was issued in 1927. The bulletins were:

No. 42—Rubber Industry in the Middle East, by Francisco G. Galang, 121 pp. 9 ill.

No. 43—How to Build Up and Improve a Herd or Flock, by Dr. David C. Kretzer, 126 pp. 33 ill.

No. 44—Vegetable Gardening and Truck Farming in the Philippines, by Aniano Elayda and Emilio K. Morada, 77 pp.

No. 45—Rural Credit Handbook, by Julian C. Balmaseda, 266 pp.

No. 46—Coffee Culture, by Francisco G. Galang, 60 pp. 32 ill.

No. 38—Mindanao and the Sulu Archipelago: Their Natural Resources and Opportunities for Development (Second Revised Edition), by P. J. Wester, 117 pp. 29 ill. 8 charts.

One thousand six hundred and seventy-four bulletins were distributed during 1928.

CIRCULARS

During the year two new circulars were released and nine old ones, reprinted. The new circulars are No. 228, *A List of Seeds and Plant Materials Available from Time to Time for Coöperative Trial Planting,* and No. 229, *A Guide for Making Panocha,* by A. Labrador.

In 1928, 142,772 circulars were distributed, most of them on poultry and swine, showing increasing interest of the farmers in live stock.

MISCELLANEOUS AGRICULTURAL INFORMATION

The work of compiling all information given out by the Bureau of Agriculture in correspondence in answer to queries received from the people was continued. The whole compilation was put out as Volume III, *Miscellaneous Agricultural Information,* in 54 pages. Four hundred copies of this booklet were mimeographed and bound and most of them were distributed to the field personnel of the Bureau.

MISCELLANEOUS PUBLICATIONS

Copies of *How to Use the Veterinary Research Laboratory Diagnosis Service* and additional copies of the English, Spanish, Tagalog, and Visayan editions of *The Most Dangerous Communicable Diseases of Domestic Animals and Their Prevention,* were printed to meet the increasing demand. A revised edition of the *Pocket Manual of Standardized Instructions for Handling Rinderpest Vaccine in the Field* was released. Thirty-four thousand seven hundred twelve miscellaneous publications were distributed.

RADIO LECTURES

A fourth series of lectures broadcasted through KZRM station, Manila, were delivered. The 12 lectures of the third series and the 28 lectures of the fourth series were printed in two booklet forms during the year.

POSTERS

Four posters were prepared during the year:

Budding and Grafting (English and Tagalog).
Raise Better Citrus Fruits (English and Tagalog).
Avian Pest (English).
Rice Stem Borer (English).

LIBRARY

Accessioning.—There were 119 books accessioned during the year.

Binding.—One hundred volumes were sent to the Bureau of Printing for binding.

Articles clipped.—About 1,944 articles were clipped and circulated to different divisions of the Bureau. These clippings are kept in the library, arranged by dates.

Subscriptions, donations, and exchanges.—The library subscribed to 30 journals and local papers, received 106 in exchange and also received and sorted for reference about 3,100 bulletins, circulars, pamphlets, leaflets and reports from the United States and other countries.

OTHER ACTIVITIES

Press items.—Seven hundred and twenty-six pages (726) of news items were released during 1928.

Translation.—Nine hundred and fifty-five pages of manuscripts, letters, etc., were translated.

Photographic work.—Five hundred and twenty-one plates, 413 films, and 48 slides were developed, and 4,190 prints and 52 enlargements were made.

Printing machines.—The work done on the multigraph and mimeograph machines is shown in the following table:

	1927	1928	Increase + Decrease —
Multigraph:			
Work orders	129	110	— 19
Copies printed	720,846	747,587	+26.741
Mimeograph:			
Work orders	769	780	+ 11
Copies printed	1.233.382	1.270,511	+37,129

FARM STATISTICS DIVISION

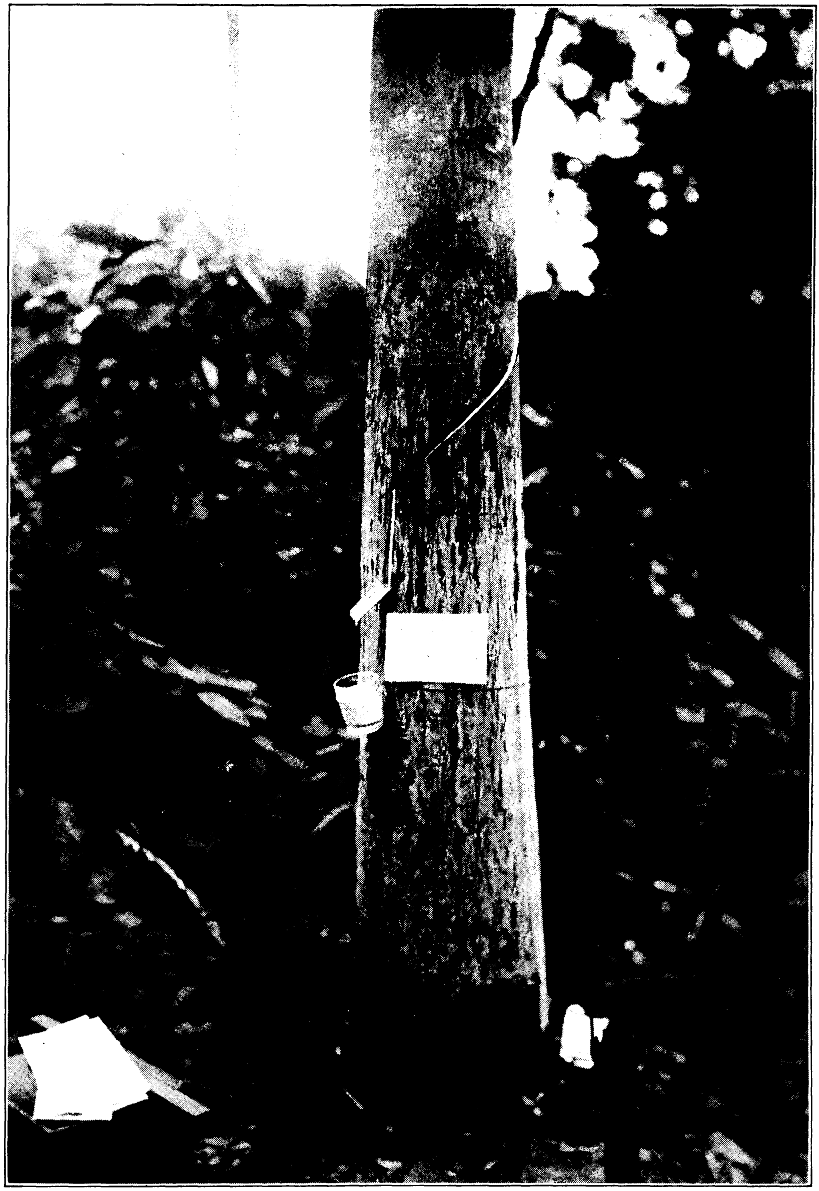
ACTIVITIES

The activities of this division consist in gathering information on crops and livestock, rural economics, and farm labor; in preparing agricultural statistics; and in estimating crop production.

The division furnishes data to legislators and government bureaus as well as to banks, manufacturers, merchants, export-

PLATE III

Para rubber plantation, Baco, Mindoro



Tapping angle showing half-spiral system

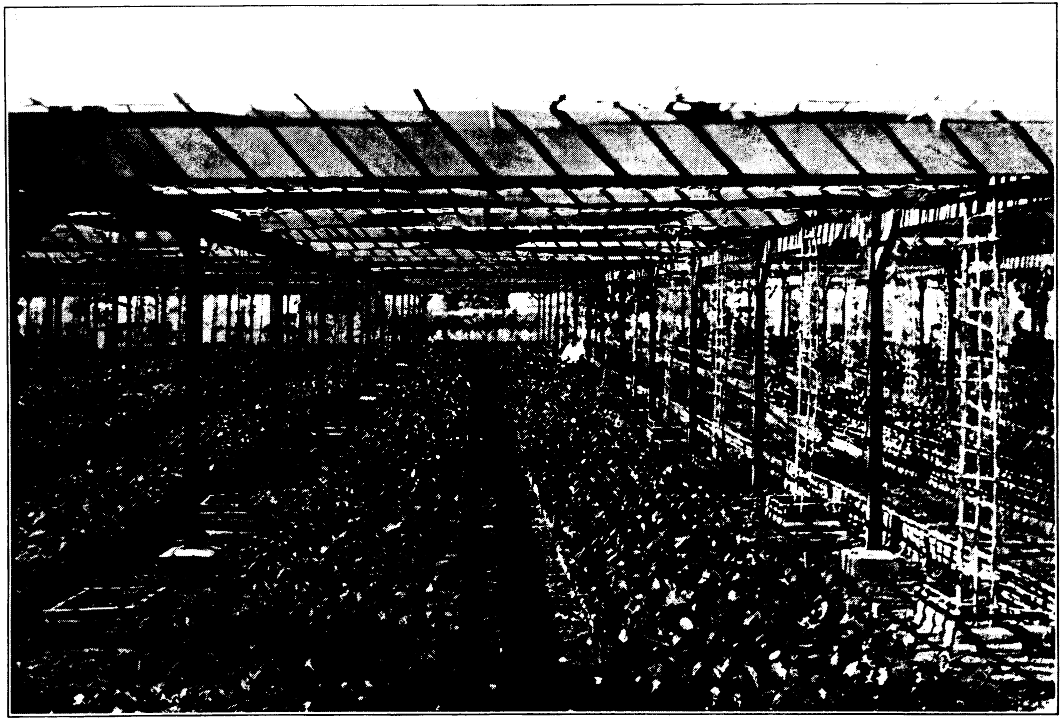
ers, importers, shipping companies, chambers of commerce, farmers and the public in general.

ACKNOWLEDGMENTS

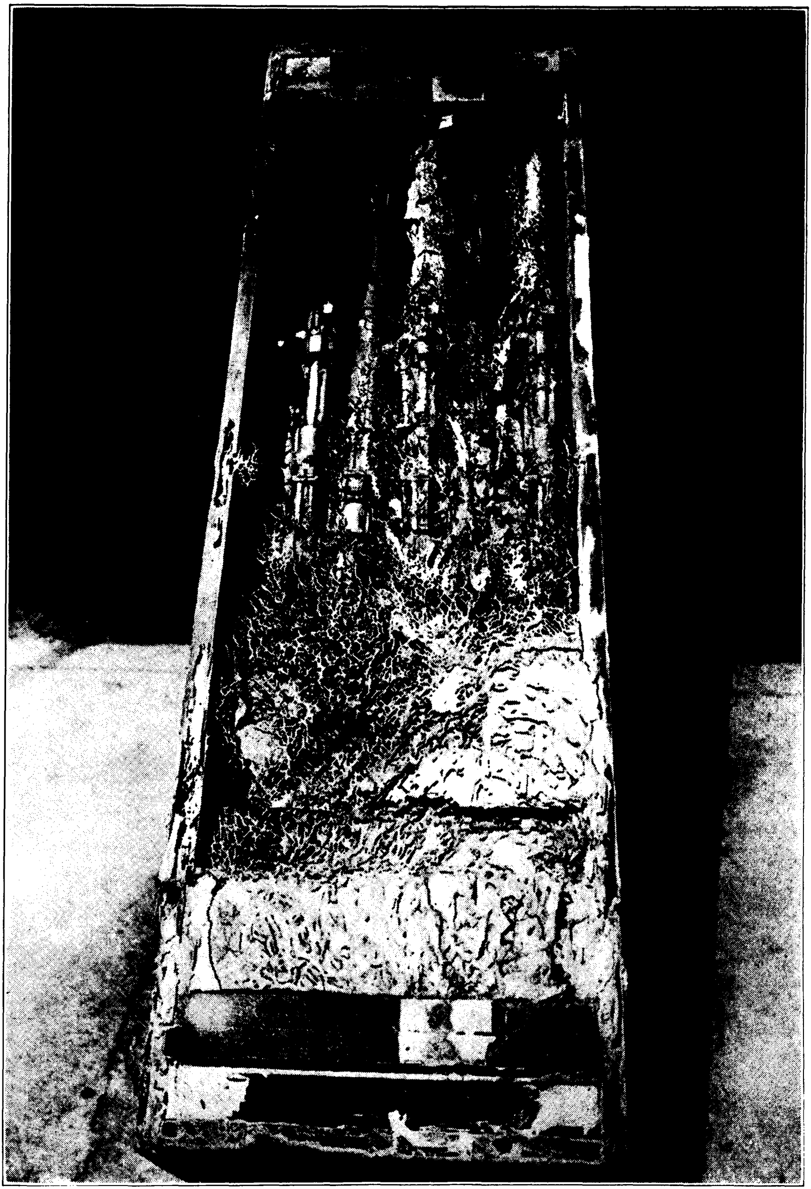
Acknowledgments are due to the municipal and provincial officials and insular bureaus, especially the Philippine Constabulary, for their splendid coöperation in the eradication of animal and plant pests and diseases, in the enforcement of the animal and plant quarantine laws and regulations, and in the food production campaigns. Deserving of special mention is the aid given by the Philippine Chapter of the American Red Cross in conducting and partly financing the food production campaign of this Bureau in the provinces devastated by the typhoon in November.

Destructive effects of the typhoon of November 22–23, 1928, on the abaca plantations in the Bicol region

PLATE VI



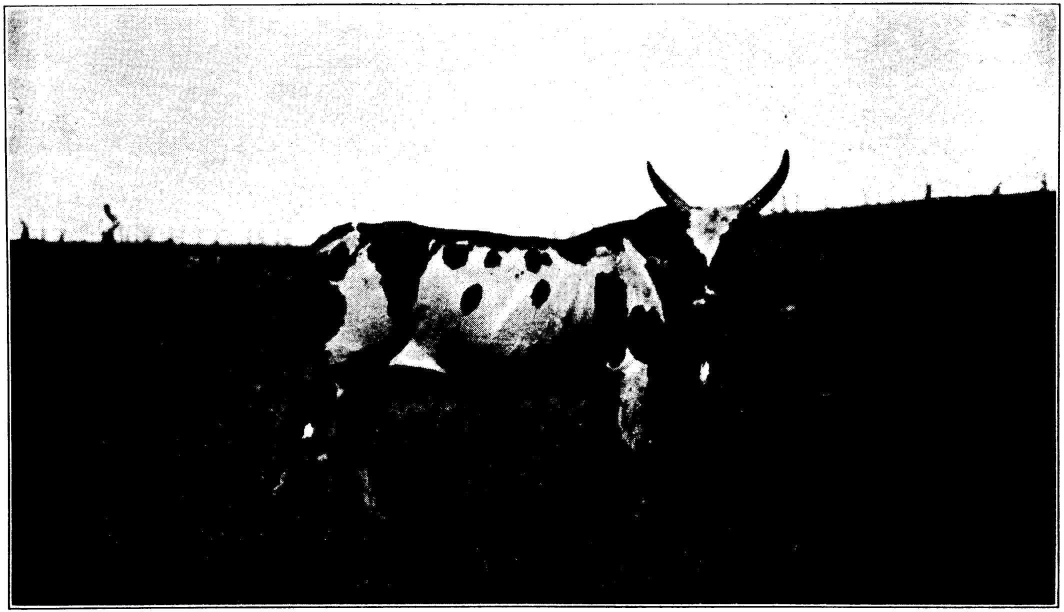
Coffee seedlings ready for distribution at the Lipa Demonstration and Propagation Station, Lipa, Batangas



Guns in storage at Fort Santiago, Manila, destroyed by white ants (*Coptotermes* sp.)

[Courtesy of Col. ODUS HORNEY, Fort Santiago.]

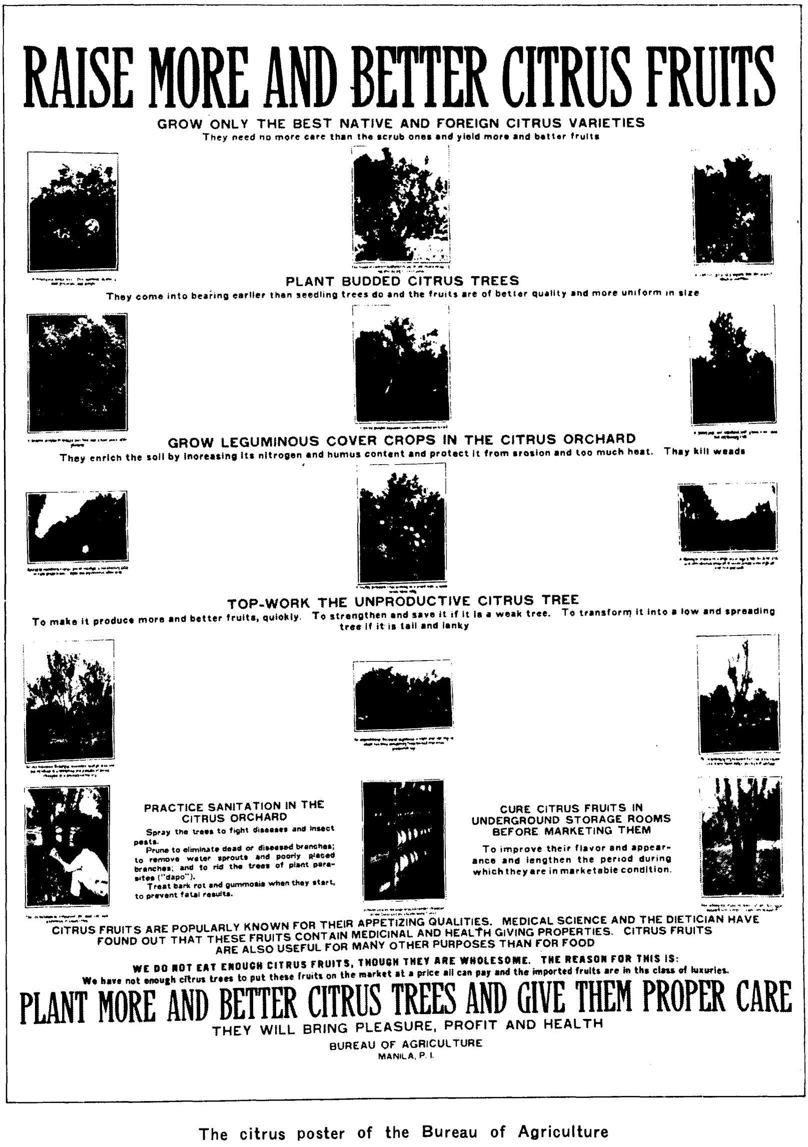
Intercepted sugar cane from Java containing a caterpillar of a moth borer (probably a species of *Diatraea*). This shows the danger of promiscuous importation of sugar-cane points from other countries.



An Ayrshire mestizo bull (Prop. No. 1243) sold to Mr. Jacinto Braga, Burgos, Pangasinan, in August, 1925

PLATE X

A ¼-Ayrshire mestizo, 2 years old, sired by grade bull No. 1243 appearing in the preceding plate



RAISE MORE AND BETTER CITRUS FRUITS

GROW ONLY THE BEST NATIVE AND FOREIGN CITRUS VARIETIES

They need no more care than the scrub ones and yield more and better fruits

PLANT BUDDED CITRUS TREES

They come into bearing earlier than seedling trees do and the fruits are of better quality and more uniform in size

GROW LEGUMINOUS COVER CROPS IN THE CITRUS ORCHARD

They enrich the soil by increasing its nitrogen and humus content and protect it from erosion and too much heat. They kill weeds

TOP-WORK THE UNPRODUCTIVE CITRUS TREE

To make it produce more and better fruits, quickly. To strengthen and save it if it is a weak tree. To transform it into a low and spreading tree if it is tall and lanky

PRACTICE SANITATION IN THE CITRUS ORCHARD

Spray the trees to fight diseases and insect pests.

Prune to eliminate dead or diseased branches; to remove water sprouts and poorly placed branches; and to rid the trees of plant parasites ("dapo").

Treat bark rot and gummosis when they start, to prevent fatal results.

CURE CITRUS FRUITS IN UNDERGROUND STORAGE ROOMS BEFORE MARKETING THEM

To improve their flavor and appearance and lengthen the period during which they are in marketable condition.

CITRUS FRUITS ARE POPULARLY KNOWN FOR THEIR APPETIZING QUALITIES. MEDICAL SCIENCE AND THE DIETICIAN HAVE FOUND OUT THAT THESE FRUITS CONTAIN MEDICINAL AND HEALTH GIVING PROPERTIES. CITRUS FRUITS ARE ALSO USEFUL FOR MANY OTHER PURPOSES THAN FOR FOOD

WE DO NOT EAT ENOUGH CITRUS FRUITS, THOUGH THEY ARE WHOLESOME. THE REASON FOR THIS IS:

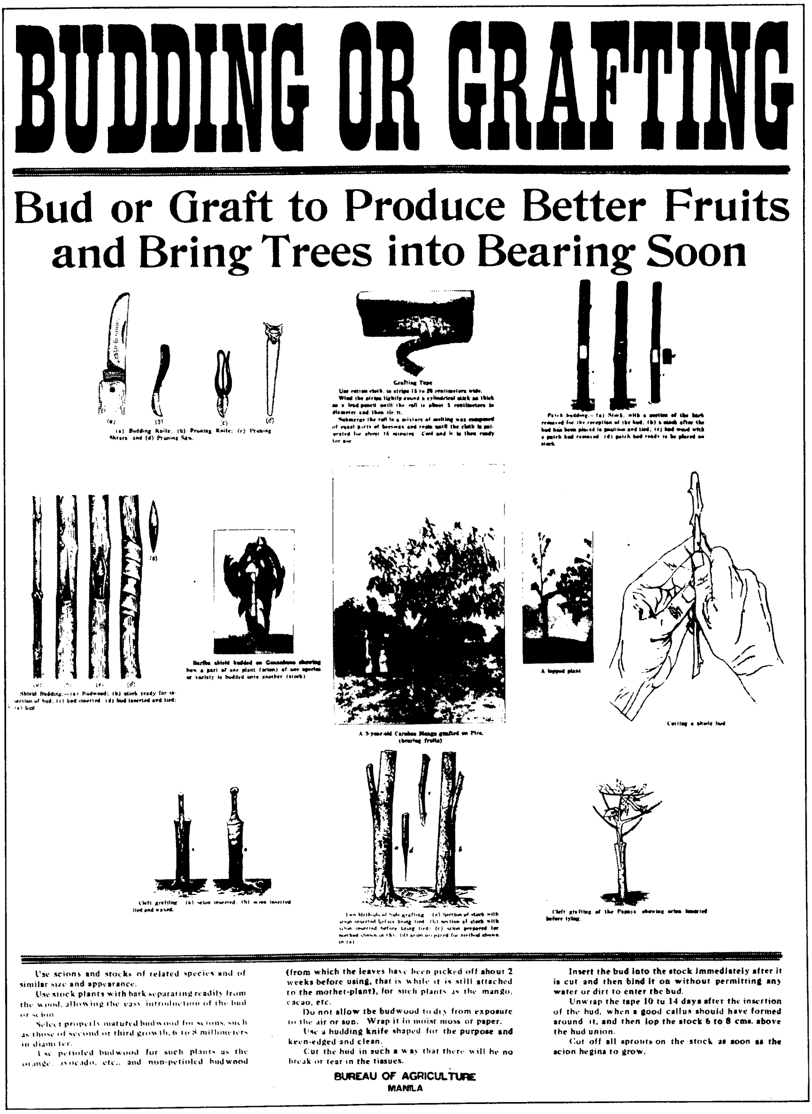
We have not enough citrus trees to put these fruits on the market at a price all can pay and the imported fruits are in the class of luxuries.

PLANT MORE AND BETTER CITRUS TREES AND GIVE THEM PROPER CARE

THEY WILL BRING PLEASURE, PROFIT AND HEALTH

BUREAU OF AGRICULTURE
MANILA, P. I.

The citrus poster of the Bureau of Agriculture



BUDDING OR GRAFTING

Bud or Graft to Produce Better Fruits and Bring Trees into Bearing Soon

(a) Budding Knife; (b) Pruning Knife; (c) Pruning Shears and (d) Pruning Saw.

Grafting Tape

Use cotton cloth, in strips 15 to 20 centimeters wide.

Wind the strips lightly round a cylindrical stick as thick as a lead-pencil until the roll is about 5 centimeters in diameter and then tie it.

Submerge the roll in a mixture of melting wax composed of equal parts of beeswax and resin until the cloth is saturated for about 15 minutes. Cool and it is then ready for use.

Patch budding.—(a) Stock, with a section of the bark removed for the reception of the bud; (b) a stock after the bud has been placed in position and tied; (c) bud wood with a patch bud removed; (d) patch bud ready to be placed on stock.

Shield Budding.—(a) Budwood; (b) stock ready for insertion of bud; (c) bud inserted; (d) bud inserted and tied; (e) bud

Bariba shield budded on Guanabano showing how a part of one plant (scion) of one species or variety is budded onto another (stock)

A 5-year-old Carabao Mango grafted on Pico. (bearing fruits)

A lopped plant

Cutting a shield bud

Cleft grafting.—(a) scion inserted; (b) scion inserted tied and waxed.

Two Methods of Side-grafting.—(a) Section of stock with scion inserted before being tied; (b) section of stock with scion inserted before being tied; (c) scion prepared for method shown in (b); (d) scion prepared for method shown in (a).

Cleft grafting of the Papaya showing scion inserted before tying.

Use scions and stocks of related species and of similar size and appearance.

Use stock plants with bark separating readily from the wood, allowing the easy introduction of the bud or scion.

Select properly matured budwood for scions, such as those of second or third growth, 6 to 8 millimeters in diameter.

Use petioled budwood for such plants as the orange, avocado, etc., and non-petioled budwood (from which the leaves have been picked off about 2 weeks before using, that is while it is still attached to the mother-plant), for such plants as the mango, cacao, etc.

Do not allow the budwood to dry from exposure to the air or sun. Wrap it in moist moss or paper.

Use a budding knife shaped for the purpose and keen-edged and clean.

Cut the bud in such a way that there will be no break or tear in the tissues.

Insert the bud into the stock immediately after it is cut and then bind it on without permitting any water or dirt to enter the bud.

Unwrap the tape 10 to 14 days after the insertion of the bud, when a good callus should have formed around it, and then lop the stock 6 to 8 cms. above the bud union.

Cut off all sprouts on the stock as soon as the scion begins to grow.

BUREAU OF AGRICULTURE
MANILA

The poster on budding and grafting

STORING FARM CROP SEEDS[1]

By

TORIBIO VIBAR

Formerly Assistant Professor in Agronomy, U. P.,
now of the Division of Vocational Education,
Bureau of Education

and

PEDRO A. RODRIGO

Formerly Instructor in Agronomy, U. P., now Assistant Agronomist,
Bureau of Agriculture

The viability of seeds decreases rapidly in the Philippines because of high moisture-temperature conditions prevailing throughout the year. The average annual rainfall of the Islands is about 2,366 millimeters, the relative humidity 80 per cent, and the temperature 26.9° C.[2] Also the methods of storage followed by Filipino farmers deleteriously affect the viability of their farm crop seeds. They store the seeds for planting in various ways; in bags, in earthen jars, and in baskets. For small quantities of seeds, bamboo joints, cans, and bottles are used. Some seeds are hung over native stoves for drying and for preservation. Corn ears for seed are hung in well ventilated places.

The main object of this experiment was to find an economical and practical way to store farm crop seeds under Philippine conditions, one that would be superior to the practices commonly followed by our farmers. Incidentally, the longevity of the farm crop seeds used under different methods of storing was determined.

MATERIALS AND METHODS

This report deals with the storage of seeds under three conditions: (1) in sealed containers (desiccators of about three liters capacity were used); (2) in sealed containers with naphthalene; and (3) in cloth bags. These three conditions for the storage of the seeds were used for the following reasons: Seed that is used for planting is stored in bags which are exposed to air; some of the containers used for seed storage can be sealed without much effort; naphthalene has proved the cheapest substance that has been used in our laboratory as a protection against insects, and it has also proved to be a good insecticide.

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[1] Part of this paper was read before the Los Baños Biological Club, November 24, 1925, and in the Third Pan-Pacific Science Congress, November, 1926, Tokyo, Japan.

[2] Coronas, Jose. 1920. The Climate and Weather of the Philippines from 1903 to 1918. 3–195 pp. Manila: Bureau of Printing.

In this experiment, the following kinds of seeds were used: Inintiw, a variety of rice that can be used for planting under both upland and irrigated conditions; Hambas, a variety of lowland rice; Calauan Yellow Flint, a yellow flinty corn; Moro corn, a white corn, less flinty than Calauan Yellow Flint; Australian Yellow Dent, a yellow starchy dent corn; mungo (*Phaseolus aureus*); Ami soy bean, a white soy bean of medium-sized seed; cowpea, New Era variety; peanuts, Spanish variety; and Tapilan (*Phaseolus calcaratus*), a white and black variety.

Table 1 shows the date of harvesting of the different kinds of seeds used in the experiment.

TABLE 1.—*Showing the date of harvesting of the seeds used*

Variety name	Date
Inintiw rice	January 15, 1924
Hambas rice	January 15, 1924
Calauan Yellow Flint corn	February 9, 1924
Moro corn	February 15, 1924
Australian Yellow Dent corn	February 12, 1924
Yellow mungo	March 7, 1924
Ami soy bean	January 23, 1924
New Era cowpea	March 5, 1924
Spanish peanuts	October 5, 1924
Tapilan (white)	January 23, 1924
Tapilan (black)	February 15, 1924

After harvesting the seeds were dried on a cement floor until they no longer lost in weight. This drying required from three to six days, the number varying with the different kinds of seeds. About two liters of each kind of seed were placed in sealed containers, two liters in sealed containers with naphthalene, and two liters in cloth bags. The seeds were placed in racks under laboratory conditions. From March 15, 1924, the date of the beginning of the experiment, to October 15, 1924, the germination of the seeds was determined every month. From October 15, 1924, to October 15, 1928, the viability of the seeds was tested every second month. One hundred seeds were used in the monthly tests, and 25 in the bi-monthly. Sterilized sawdust was used as a germinating medium the first few months, then sand was used. The reading of the germination was done a week after the seeds were placed in the germinator. This period is satisfactory under Philippine conditions.

The experiment was conducted in the laboratory of the Division of Farm Crops of the Philippine College of Agriculture. The data here presented consist of results obtained from April, 1924 to October, 1928. Data from 1924 to 1926 were reported in the Third Pan-Pacific Science Congress held in Tokyo in 1926.

RESULTS

Table 2 shows the germination of rice seeds; table 3, the germination of corn seeds; table 4, leguminous seeds; and table 5, peanut seeds.

TABLE 2.—*Showing the longevity of rice seeds under different methods of storing*

Date tested	Age of seed	Variety Hambas			Variety Inintiw		
		Sealed container naphthalene	Sealed container	Cloth bag	Sealed container napthalene	Sealed container	Cloth bag
1924	*Months*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
April 2	2.6	97	(Initial)		98	(Initial)	
April 15	3	98	98	92	99	97	98
June 15	5	99	97	98	99	96	96
July 15	6	97	97	94	99	97	97
August 15	7	96	97	94	99	99	98
September 15	8	97	98	94	96	96	94
October 15	9	97	96	92	97	96	91
December 15	11	100	100	92	96	96	96
1925							
February 15	13	100	100	76	100	100	92
April 15	15	96	100	56	100	100	72
June 15	17	100	100	48	100	96	44
August 15	19	100	96	0	100	96	28
October 15	21	100	96	0	100	100	0
December 15	23	96	96	0	96	96	0
1926							
February 15	25	96	100	0	100	92	0
April 15	27	92	100	0	80	88	0
June 15	29	100	100	0	88	92	....
August 30	31.5	96	100	....	100	100	....
October 15	33	100	100	....	96	92	....
December 15	35	96	96	....	96	92	....
1927							
February 15	37	96	92	....	100	96	....
April 16	39	92	92	....	96	96	....
June 15	41	88	92	....	92	92	....
August 15	43	88	96	....	96	88	....
October 15	45	84	96	....	88	92	....
December 15	47	92	84	....	96	96	....
1928							
February 15	49	92	96	....	84	92	....
April 16	51	92	88	....	92	92	....
June 30	53.5	76	88	....	92	88	....
August 15	55	84	72	....	96	88	....
October 15	57	60	80	....	80	92	....

Table 3.—*Showing the longevity of corn seeds under different methods of storing*

Date tested	Age of seed	Calauan Yellow Flint			Moro			Australian Yellow Dent		
		Sealed container with naphthalene	Sealed container	Cloth bag	Sealed container with naphthalene	Sealed container	Cloth bag	Sealed container with naphthalene	Sealed container	Cloth bag
1924	*Months*	*P. ct.*	*P. ct.*	*P. vt.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
March 15	1	100	(Initial)		100	(Initial)		100	(Initial)	
April 15	2	100	100	100	100	99	100	100	100	92
June 15	4	100	100	99	100	99	100	100	98	86
July 15	5	100	100	100	100	100	100	98	96	70
August 15	6	100	100	100	100	99	98	100	96	44
September 15	7	100	100	100	100	100	98	98	96	12
October 15	8	100	100	100	100	100	93	100	98	0
December 15	10	100	100	100	100	100	76	100	100	0
1925										
February 15	12	100	100	76	100	100	44	100	100	0
April 15	14	100	100	64	100	100	28	100	96	0
June 15	16	100	100	60	100	100	28	96	100	0
August 15	18	100	100	20	100	100	0	100	96	......
October 15	20	100	100	0	96	100	0	100	96	......
December 15	22	100	100	0	100	100	0	96	92	......
1926										
February 15	24	100	100	0	96	100	0	96	88	......
April 15	26	96	96	0	96	92	0	88	82	......
June 15	28	100	100	0	100	100	0	92	88	......
August 30	30.5	96	96	0	96	100	......	96	88	......
October 15	32	100	100	......	88	100	......	100	100	......
December 15	34	96	100	......	92	100	......	96	96	......
1927										
February 15	36	96	96	......	92	96	......	84	100	......
April 16	38	92	96	......	88	96	......	84	100	......
June 15	40	100	100	......	80	88	......	84	100	......
August 15	42	92	96	......	76	92	......	88	88	......
October 15	44	92	100	......	64	60	......	88	88	......
December 15	46	100	92	......	52	68	......	68	84	......
1928										
February 15	48	96	96	......	16	72	......	32	92	......
April 16	50	92	88	......	24	68	......	12	88	......
June 30	52.5	92	96	......	16	32	......	0	80	......
August 15	54	88	92	......	8	36	......	0	88	......
October 15	56	44	36	......	0	20	......	0	92	......

TABLE 4.—*Showing the longevity of some leguminous seeds under different methods of storing*

Date tested	Age of seed	Mungo			Cowpeas		
		Sealed container with naphthalene	Sealed container	Cloth bag	Sealed container with naphthalene	Sealed container	Cloth bag
1924	*Months*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
March 15	.3	100	(Initial)		99	(Initial)	
April 15	1.3	100	100	100	97	95	97
June 15	3.3	99	100	100	96	93	80
July 15	4.3	99	100	98	96	92	85
August 15	5.3	99	99	99	98	87	[a] 45
September 15	6.3	100	99	96	98	92	35
October 15	7.3	99	99	99	96	92	28
December 15	9.3	100	100	96	96	92	20
1925							
February 15	11.3	100	100	96	100	96	16
April 15	13.3	100	100	100	100	88	12
June 15	15.3	100	100	100	96	82	12
August 15	17.3	100	100	100	96	96	0
October 15	19.3	100	100	100	100	100	0
December 15	21.3	100	100	100	100	92	0
1926							
February 15	23.3	100	100	100	92	100	0
April 15	25.3	100	96	100	88	84	0
June 15	27.3	96	92	80	92	84	....
August 30	29.8	96	96	92	80	88	....
October 15	31.3	96	96	92	80	84	....
December 15	33.3	100	100	96	92	88	....
1927							
February 15	35.3	100	100	88	84	92	....
April 16	37.3	100	96	88	84	92	....
June 15	39.3	100	96	84	80	88	....
August 15	41.3	92	100	88	80	88	....
October 15	43.3	100	100	100	88	88	....
December 15	45.3	96	92	100	92	96	....
1928							
February 15	47.3	92	100	80	84	88	....
April 16	49.3	100	92	88	80	88	....
June 30	51.8	100	84	[a] 32	80	88	....
August 15	53.3	100	92	32	92	84	....
October 15	55.3	88	92	32	96	88	....

[a] Attacked by weevils.

TABLE 4.—*Showing the longevity of some leguminous seeds under different methods of storing*—Continued

Date tested	Age of seed	Soy bean			Tapilan (white)		
		Sealed container with naphthalene	Sealed container	Cloth bag	Sealed container with naphthalene	Sealed container	Cloth bag
1924	*Months*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
March 15	1.7	94	(Initial)		96	(Initial)	
April 15	2.7	88	88	86	94	88	89
June 15	4.7	88	87	84	92	92	87
July 15	5.7	87	87	82	92	89	94
August 15	6.7	88	87	74	93	91	92
September 15	7.7	88	86	66	94	90	89
October 15	8.7	87	85	63	98	89	85
December 15	10.7	92	92	56	92	88	84
1925							
February 15	12.7	88	92	12	100	92	76
April 15	14.7	84	76	4	96	96	20
June 15	16.7	84	80	4	96	92	16
August 15	18.7	84	68	0	92	82	12
October 15	20.7	76	68	0	96	88	12
December 15	22.7	76	68	0	92	96	4
1926							
February 15	24.7	80	60	0	92	92	4
April 15	26.7	....	....	0	92	88	0
June 15	28.7	64	60	0	96	96	0
August 30	31.2	64	60	0	92	96	0
October 15	32.7	68	60	0	88	96	0
December 15	34.7	56	44	0	80	80	0
1927							
February 15	36.7	28	20	0	92	88	0
April 16	38.7	....	....	0	96	88	0
June 15	40.7	20	12	0	92	84	0
August 15	42.7	56	44	0	88	80	0
October 15	44.7	44	24	0	80	84	0
December 15	46.7	36	16	0	76	84	0
1928							
February 15	48.7	16	0	0	88	80	0
April 16	50.7	4	0	0	88	76	0
June 30	52.7	8	8	0	72	76	0
August 15	54.7	0	0	0	68	88	0
October 15	56.7	0	0	0	64	76	0

TABLE 4.—*Showing the longevity of some leguminous seeds under different methods of storing*—Continued

Date tested	Tapilan (black)			
	Age of seed	Sealed container with naphthalene	Sealed container	Cloth bag
1924	*Months*	*Per cent*	*Per cent*	*Per cent*
March 15	1	80	(Initial)	
April 15	2	78	80	72
June 15	3	78	75	79
July 15	4	76	75	75
August 15	5	74	68	75
September 15	6	76	68	75
October 15	7	65	65	65
December 15	9	76	84	84
1925				
February 15	11	72	76	84
April 15	13	60	76	80
June 15	15	68	72	84
August 15	17	64	68	64
October 15	19	72	56	52
December 15	21	64	64	40
1926				
February 15	23	64	64	40
April 15	25	60	56	36
June 15	27	56	48	44
August 30	29	60	52	48
October 15	31	56	52	44
December 15	33	76	76	40
1927				
February 15	35	64	60	40
April 16	37	56	52	36
June 15	39	48	40	36
August 15	41	52	52	20
October 15	43	64	40	36
December 16	45	60	36	32
1928				
February 15	47	60	48	28
April 16	49	52	56	36
June 30	51	64	68	36
August 15	53	72	68	52
October 15	55	48	80	40

TABLE 5.—*Showing the longevity of hulled and unhulled Spanish peanuts under different methods of storing*

Date tested	Age of seed	Hulled seed			Unhulled seed		
		Sealed container with naphthalene	Sealed container	Cloth bag	Sealed container with naphthalene	Sealed container	Cloth bag
1925	*Months*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
December 31	3.0	100	(Initial)		100	(Initial)	
February 15	4.5	100	100	100	100	100	100
April 15	6.5	100	100	92	100	96	96
August15	8.5	100	100	88	100	100	100
October 15	10.5	100	96	36	100	100	88
December 15	12.5	96	96	0	100	100	60
1926							
February 15	14.5	92	80	....	100	100	20
April 15	16.5	....	....	....	100	100	0
June 16	18.5	56	48	....	96	80	0
August 30	21.0	60	52	....	96	92	0
October 15	22.5	40	32	....	96	96	0
December 15	24.5	8	4	....	100	100	....
1927							
February 15	26.5	0	0	....	88	68	....
April 16	28.5	0	0	....	28	24	....
June 15	30.5	0	0	....	16	20	....
August 15	32.5	....	....	....	20	12	....
October 15	34.5	....	....	....	16	16	....
December 15	36.5	....	....	....	0	0	....
1928							
February 15	38.5	....	....	....	0	0	....
April 15	40.5	....	....	....	0	0	....

DISCUSSION OF RESULTS

Rice.—As shown in Table 2, the rice seed stored in sealed containers with and without naphthalene remained strongly viable even after four years in storage, the percentage of germination ranging from 84 to 96 during the last test in the fourth year. In the fifth year, there was a slight sign of deterioration; this seemed to be more apparent with the seeds treated with naphthalene. The percentage of germination of those stored with naphthalene during the last test in the fifth year was 60 for the variety Hambas and 80 for Inintiw, while in the case of those without naphthalene, the percentage of germination was 80 for Hambas and 92 for Inintiw.

In cloth bags the decrease of viability was evident after 13 months of storage in the case of the Hambas variety, and after 15 months in the case of Inintiw rice. Complete loss of vitality occurred after 20 to 21 months of storage in cloth bags.

Corn.—In sealed containers with and without naphthalene, the viability of Calauan Yellow Flint remained good till the fifty-fourth month under storage; that of Moro till the fortieth to the forty-second month; and that of Australian Yellow Dent, till the forty-fourth month with naphthalene, and till the fifty-sixth month without naphthalene. The viability of the corn seeds stored with naphthalene became critical after 54 months in storage in the case of Calauan Yellow Flint; that of Moro, after 40 months and was completely lost after 56 months. The viability of Australian Yellow Dent was very low after 44 months and completely gone after 52 months in storage.

The seeds stored without naphthalene had a longer longevity. Australian Yellow Dent still gave a high percentage of germination after 56 months in storage. Calauan Yellow Flint became critical in viability after 54 months and Moro after 42 months, but some seeds still germinated after 56 months in storage.

In cloth bags the viability of the seeds became critical as follows: Calauan Yellow Flint, in 10 to 12 months; Moro, in 8 to 10 months; and Australian Yellow Dent, in 5 to 6 months. There was complete loss of viability in Calauan Yellow Flint after 20 months of storage in cloth bag, in the Moro after 18 months, and in Australian Yellow Dent after 8 months.

LEGUMES

Mungo.—There was no positive sign of loss of viability after 55 months of storage in the sealed containers whether with or without naphthalene, the percentage of germination during the fifty-fifth month being 88 with and 92 without naphthalene. The viability of the mungo seed in cloth bags began to be critical in the fifty-second month in storage.

Cowpea.—In sealed containers with and without naphthalene, there was no evident decrease of viability at the end of 55 months in storage (see Table 4.) In cloth bags the viability of the seed decreased at the end of 5 months in storage; and from this time on the decrease in viability was rapid, reaching zero at the end of 17 months.

Soybean.—As shown in table 4, the soybean seeds stored in sealed containers without naphthalene showed a marked loss of viability after 18 months in storage, while those in sealed containers with naphthalene showed signs of deterioration in viability after 26 months in storage. In cloth bags, the viability of the seeds began to decrease appreciably at the end of 6 months in storage; and from this time on the viability decreased, reaching the zero point of germination at the end of 18 months.

Tapilan.—The viability of the seeds of the white variety became critical after 52 months in storage in the case of those stored in sealed containers with naphthalene, and after 56 months in the case of those stored in sealed containers without naphthalene. The viability of the seeds in cloth bags decreased at the end of 11 months in storage, reaching the zero point after 26 months. The seeds of the black variety stored in sealed containers with and without napthalene showed decrease in viability after 33 months in storage, while those in cloth bags showed signs of deterioration after 19 months. At the end of 55 months in storage the seeds in all containers showed about 40 to 50 per cent germination.

Peanuts.—The hulled seed peanuts lost their viability sooner than those in pods (see Table 5). The hulled seed peanuts stored in sealed containers with and without naphthalene had their viability become critical at the end of 16 months in storage. The unhulled peanuts under the same method of storing and treatment showed a marked decrease in the percentage of germination after 26 months in storage. The hulled seed peanuts had a zero per cent of germination after 24 months; the unhulled seed reached the zero point after 36 months in storage. The hulled seed in cloth bags had an apparent decrease of viability after 8 months, and the unhulled seed after 10 months in storage. Hulled seed reached zero per cent of germination after 12.5 months and unhulled after 16.5 months in storage.

EFFECT OF NAPHTHALENE ON THE VIABILITY OF SEED IN STORAGE

After 55 to 57 months in storage, except in the case of corn and rice, naphthalene did not appear to have any effect on the viability of the seeds used. The viability of the seeds stored under similar conditions and treated with naphthalene was pratically the same as for those without any naphthalene treatment. In the case of corn, however, the naphthalene put with the seed appeared to have lessened its viability, but not until after about 46 months in storage (see Table 2). In the case of rice, naphthalene appeared to have a slightly bad effect on the viability of the seed after 57 months in storage.

The corn seed treated with naphthalene, as a whole, had a lower percentage of germination than the untreated seed. Naphthalene, nevertheless, is of great importance, especially when storing seeds in containers that are not absolutely air-tight. Naphthalene suffocates and kills ordinary grain weevils that attack seeds in storage, thus saving the seeds from their attack.

The fact that seeds stored in sealed containers with and without naphthalene remained strongly viable for two to four and one-half years, and those in cloth bags lost viability in less than a year, generally, has a far-reaching significance in Philippine agriculture, particularly in fostering better cropping. Good seeds for planting could be made available any time of the year by storing them in sealed containers after thorough drying. This method of storing does away with the destructive effect of high humidity. For small amounts of seeds, bottles and small glass jars that can be sealed are good. For large amounts of seeds, petroleum or gasoline cans have proved very satisfactory in the College of Agriculture. They can be shipped to long distances without the seeds being removed from them.

SUMMARY OF CONCLUSIONS

The results obtained in more than four years of study that are presented in this paper justify the following conclusions:

1. *Rice.*—The rice seed stored in cloth bags began to show poor viability after 13 to 15 months in storage; that in sealed containers was still good for planting purposes after 51 months, and gave a percentage of germination ranging from 60 to 92 after 57 months in storage. The rice seed stored in cloth bags completely lost its viability after 19 to 21 months in storage.

2. *Corn.*—Corn seed stored in sealed containers with naphthalene was still strongly viable after 38 to 54 months in storage; that in sealed containers without any treatment, after 40 to 56 months, while seed stored in cloth bags completely lost its vitality in from 7 to 20 months.

Naphthalene lessened the viability of corn seed in storage, and the effect was particularly pronounced in the case of the Dent corn (Australian Yellow Dent) and Moro, a rather soft flint corn.

3. *Mungo.*—Mungo seed stored in sealed containers with or without naphthalene remained strongly viable after 55 months in storage. The seed stored in cloth bags showed poor vitality after 52 months, mainly because of the attack of weevils.

4. *Cowpea.*—After 55 months in storage, the cowpea seed stored in sealed containers with and without naphthalene was still strongly viable; that in cloth bags began to lose its vitality after five months and completely lost it after 17 months in storage.

5. *Soybean.*—The sealed containers proved better for storing soybean seeds than the cloth bags. Seed stored in cloth bags

was no longer suitable for planting purposes after six months in storage; that in sealed containers without naphthalene, after 18 months; and that in sealed containers with naphthalene, after 26 months in storage. Soybean seed stored in cloth bags completely lost its vitality after 18 months, and that in sealed containers with and without naphthalene after 55 months.

6. *Tapilan.*—In both varieties the sealed containers with and without naphthalene proved better for keeping the seed viable. The viability of the seed stored in sealed containers began to be critical after 33 to 56 months in storage; that stored in cloth bags, after 11 to 19 months.

7. *Peanuts.*—Seed peanuts did not remain viable very long even under the best methods of storing. Seed stored in sealed containers completely lost its viability after 24 to 36 months; that in cloth bags, after 12 to 16 months. Seed peanuts in the pod remained viable for a longer time than shelled seed. Shelled seed when stored in sealed containers remained good for planting purposes for about 14 months while the unhulled seed remained good for planting purposes for about 26 months.

PAPAYA CULTURE

By Emilio K. Morada
Assistant Horticulturist

The papaya, known botanically as *Carica papaya* L., is the local name in the Philippines of a tall herbaceous plant, with a light brownish or brownish green trunk below, marked by distinct leaf scars, bearing at the top large deeply lobed leaves on long hollow petioles. In some countries it is erroneously known as the melon tree and the papaw or pawpaw, a name borrowed from an American fruit, *Asimina triloba* Dunal. However, according to some authorities, the plant is now coming to be called the papaya in all English-speaking countries.

It was one of the plants introduced from Mexico by the Spaniards here. Being a tropical plant, it adapted itself easily to its new environments and as it was much relished by the Filipinos, it spread rapidly so that at present it can be found in almost all parts of the Archipelago. In many places it is being grown successfully with little or no attention. Often it grows spontaneously because of birds, wild cats and dogs which eat the flesh and seeds of the ripe fruits and excrete the latter in places where they roam about. Human beings disseminate the papaya throwing away the seeds before they eat the ripe fruits. When the rainy season or any favorable conditions for their growth comes, the seeds germinate. But very few plants thus started survive.

Although this plant can be grown easily, the growers often fail to raise them profitably because they employ crude methods of culture. This article, therefore, has for its object to describe in detail the most practical methods of culture.

KINDS OF PAPAYA

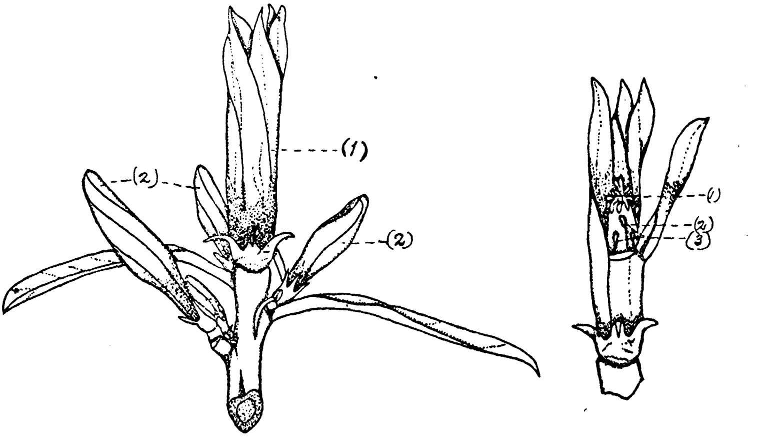
The papaya bears fruits of varied shapes due to crossing, which takes place easily in nature. Seeds from a given type when planted will produce other types so different from the original one that any attempt to classify them according to the shapes of the fruits has to be abandoned as no one shape is a permanent characteristic of the plant. The leaves and trunks and other vegetative parts of the different varieties are also so dissimilar that classification is not possible. The flowers are, therefore, the only means by which they can be segregated into different types.

Classified according to the kinds of flowers produced, the papaya may be classified into the female or pistillate papaya, the male or staminate and the hermaphrodite or monoeceous, that having both perfect and imperfect flowers on the same tree.

In the first type, the flowers are imperfect as the stamens in which the pollen grains are borne are lacking (figure 3). Consequently, either of the two latter kinds are necessary to fertilize the flowers. The fruits produced by this type are either almost oblong with a pointed and rounded tip or oblong obovate pointed tip, or obovate or rounded (figure 4). The flesh is rather thin, and the seed cavity is big in proportion to the fruit. The former type of fruits has few seeds while the latter two contain many seeds. To this type of papaya may be found to belong fruits of very good quality, sweet and fine in texture. This type also produces the most fruits and oftentimes is very early in fruiting.

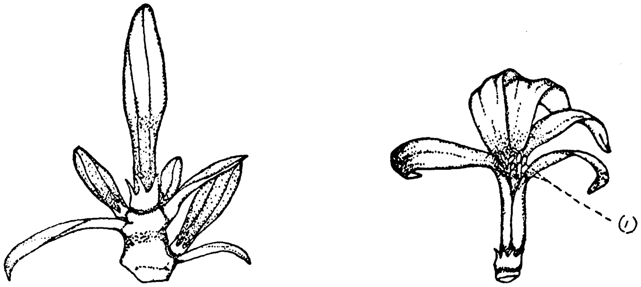
In the male or staminate papaya, the female flowers or the female parts of the flowers—the ovary and the stigma—are lacking, so no fruits are produced (figure 2). In very rare cases a few male plants produce pistillate flowers at the tip of a long bunch of male flowers which develop into small and worthless fruits. As the resulting plants from the seeds, fertilized by the pollen from the staminate type, have a larger per cent of maleness and very often do not come as true to type as when pollinated by the hermaphrodite type, it is better to kill all male plants if there are hemaphrodite plants in the plantation.

The hermaphrodite type of papaya is the one in which both perfect and imperfect flowers are borne on the same tree (figure 1(*a*)). The former are generally in the middle of a small bunch of flowers, while the latter are on the sides. The staminate flowers (figure 1 (*b*)) are regularly produced at every leaf axil while the perfect flowers are not. That is, at certain seasons or age of the tree, the latter are produced in abundance while in other stages very few or none at all appear. This may be due to some physiological factors which appear when favorable seasons occur. In this way, fertilization is insured. This type has the biggest fruit, long with pointed or rounded tip or oblong pointed or long pyriform pointed or pyriform in shape, with



(*a*) A bunch of perfect (1) and imperfect (2) flowers

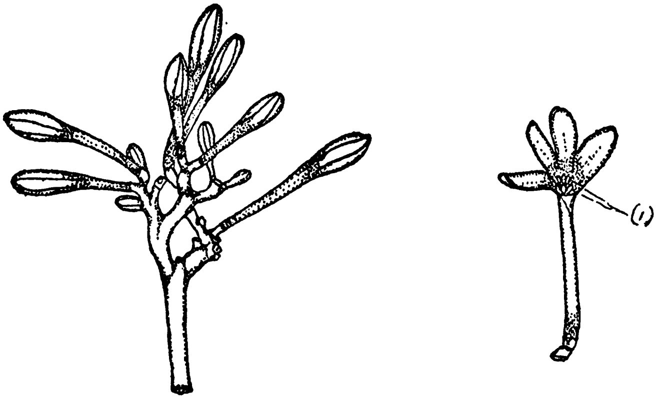
(*b*) An open perfect flower showing the stigma (1), ovary (2), and stamens (3)



(*c*) A bunch of imperfect flowers

(*d*) An open imperfect flower showing the stamens (1)

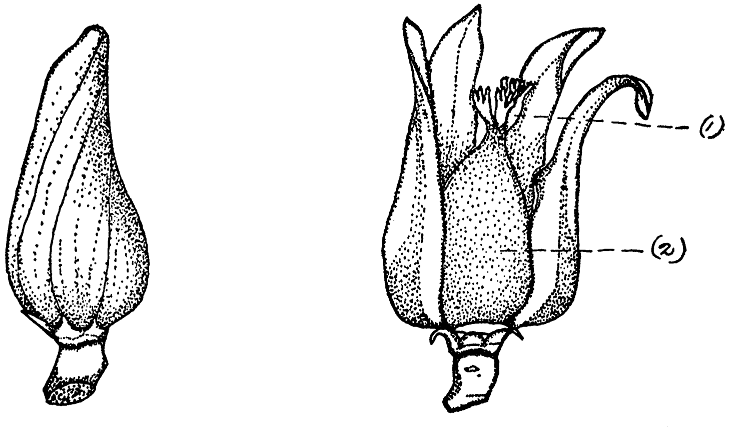
FIG. 1. Flowers of the hermaphrodite type of papaya



(*a*) A bunch of staminate flowers

(*b*) An open staminate flower showing the stamens (1)

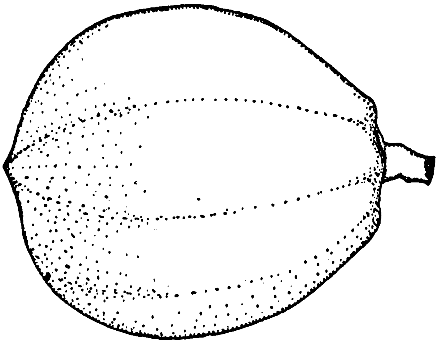
FIG. 2. Flowers of the staminate type of papaya



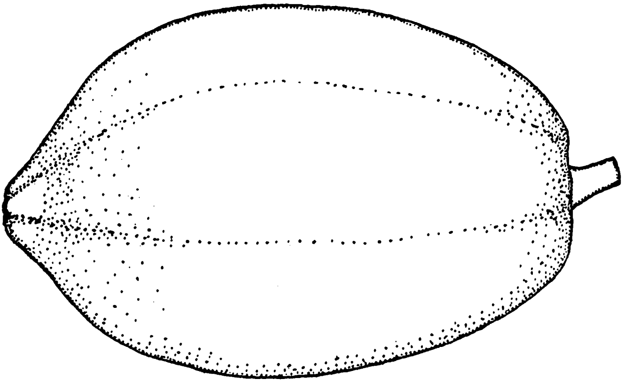
(*a*) A pistillate flower bud about to open

(*b*) An open pistillate flower showing the stigma (1) and ovary (2)

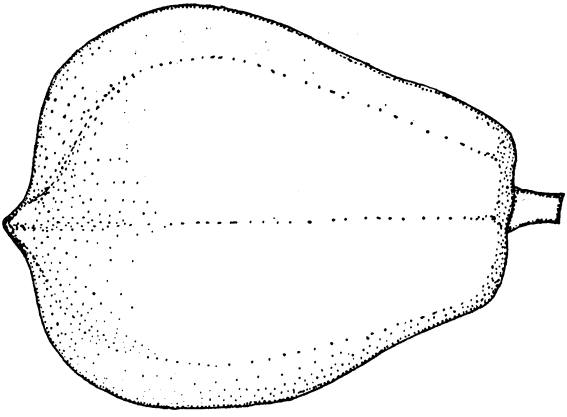
FIG. 3. Flowers of the pistillate type of papaya



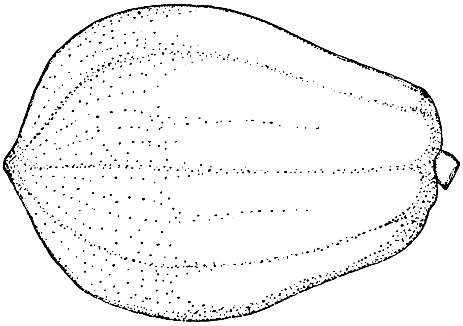
(*a*) Rounded



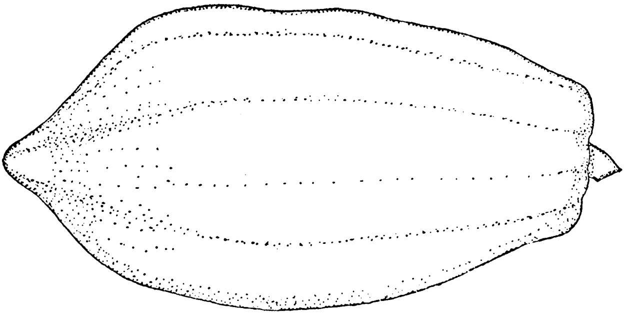
(*b*) Oblong slightly pointed tip



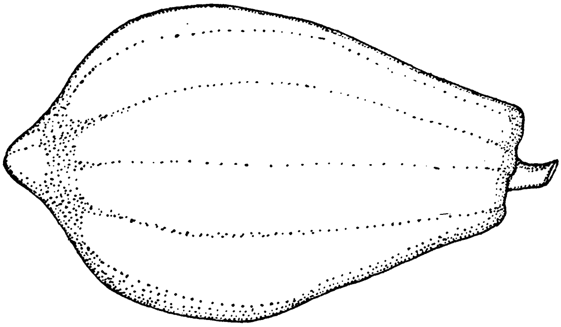
(*c*) Obovate



(*d*) Oblong obovate.

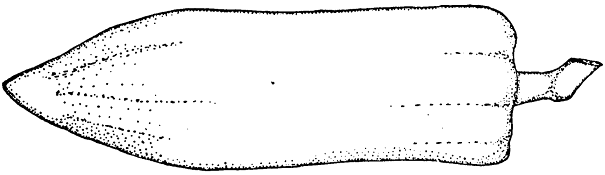


(*e*) Oblong pointed tip

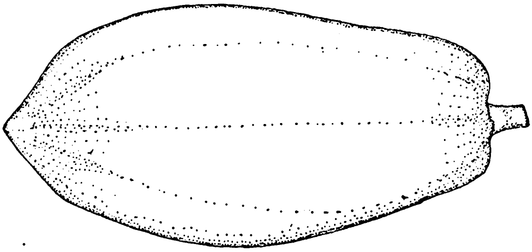


(*f*) Oblong obovate pointed tip

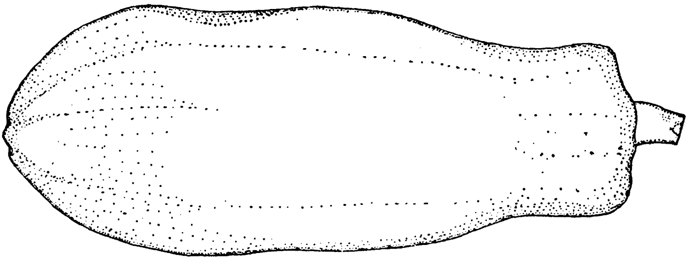
FIG. 4. Forms of fruits of the pistillate type of papaya



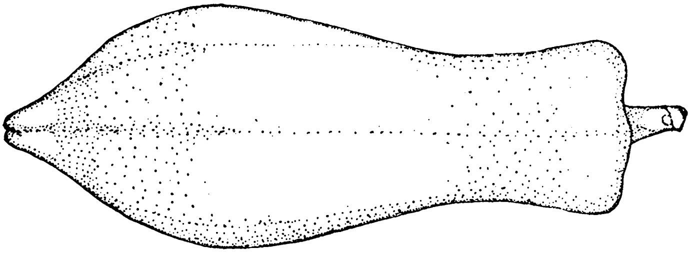
(*a*) Long pointed tip



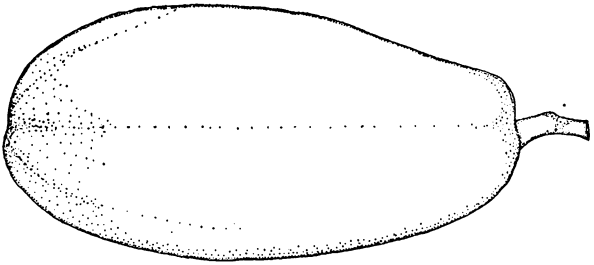
(*b*) Oblong slightly pointed tip



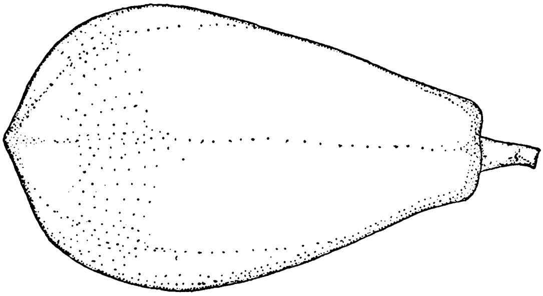
(*c*) Long rounded tip



(*d*) Long pyriform pointed tip

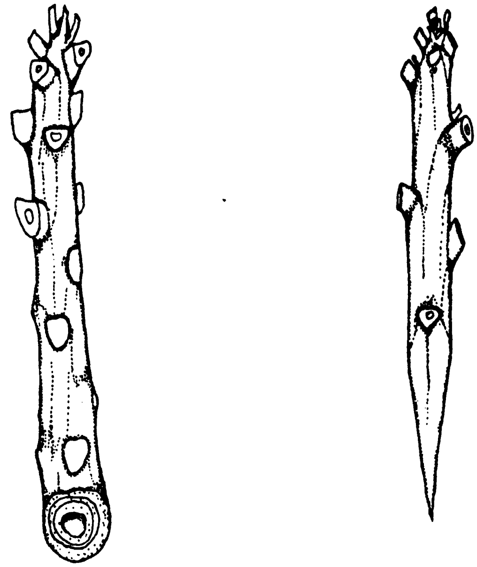


(*e*) Oblong rounded tip



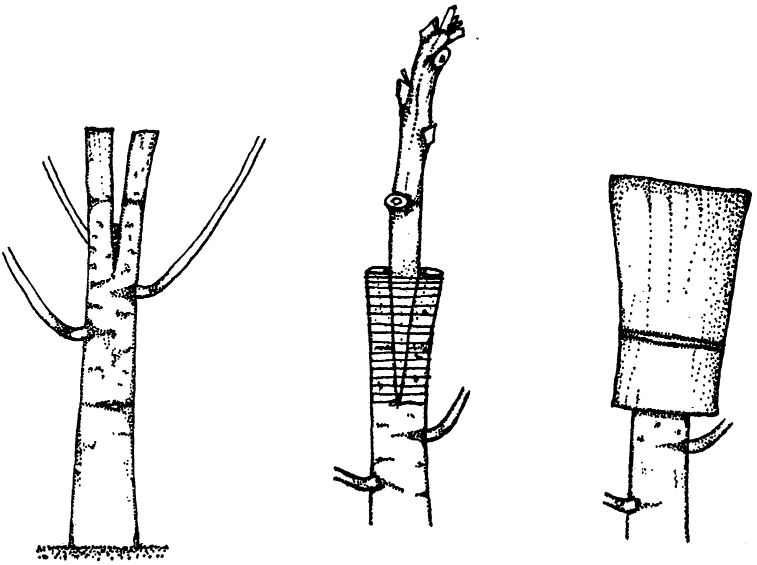
(*f*) Pyriform

FIG. 5. Forms of fruits of the hermaphrodite type of papaya



(*a*) A scion

(*b*) A scion cut wedge-shaped, ready for insertion



(*c*) A stock cut and split in the middle for receiving the scion

(*d*) A cleft graft

(*e*) A cleft graft with banana leaf-sheath or

FIG. 6. Different steps in cleft grafting

thick flesh, a small seed cavity and few seeds (figure 5). The fruits, however, are in general watery in nature and not so sweet as those of the pistillate type. The tree oftentimes grows high before fruits are produced as there is so great a preponderance of male flowers that the fruits are not as regularly produced in all axils of the leaves as in the pistillate papaya. It is, therefore, not so productive as the latter type.

CLIMATE AND SOIL

The temperature, humidity, rainfall, and prevailing winds obtaining in a place determine the successful production of a crop. Due principally to differences in altitude, distance from the sea, topography and types of vegetation papayas may be grown successfully in some places while in others its culture may be entirely a failure.

According to Father Algue, formerly Director of the Weather Bureau, the climate of the Philippines is divided into three types as follows:

FIRST TYPE

Rainfall
Heaviest: November, December, January, February.
Medium: July, August, September, October.
Lightest: March, April, May, June.
Total yearly: 2,766 millimeters.
No dry season.

Humidity: Small range of humidity, 78–88 per cent.
Temperature: Averages less than 27° C.

SECOND TYPE

Rainfall
Heaviest: June, July, August, September, October.
Medium: November, December, April, May.
Lightest: January, February, March.
Total yearly: 2,453 millimeters.
Very distinct wet and dry seasons.
(Dry season lasts from 5 to 6 months.)

Humidity: Large range, 70–86 per cent.
Temperature: Around 27° C.

THIRD TYPE

Rainfall
Heaviest: July, August, September, October, November.
Medium: May, June, December, January.
Lightest: February, March, April.
Total yearly: 1,856 millimeters.
Short period of dry season: January, April.
(Dry season lasts from one to two months.)

Humidity: Very small range.
Temperature: Around 26° C.

The most suitable climate for papaya is the third type, in which the dry season is quite short, and the rainfalls are fairly well distributed throughout the year, as in Laguna, Tayabas, and the Bicol provinces. The papaya may be grown also under the other two types but the success will not be so complete as under the third type. In the second type, the dry season is so long that the plants no matter how vigorously they grow during the rainy season, become stunted and wilted in the hot part of the day during the dry season, which causes the plant to stop fruiting. Under the first type the rainfalls are so heavy that they become harmful to the papaya trees. Also the absence of a dry season prevents the early maturing of the fruits and too much water makes them watery.

Strong winds are injurious to the plants. They should be planted in a well-sheltered place or, in the absence of natural wind-breaks, economic plants such as the mango, mabolo, caimito, and others should be planted against the direction of the prevailing winds.

The papaya grows best in a fairly deep soil, loose, friable, well drained and rich in organic matter. This kind of soil is often found in a place where bamboo has been grown.

PROPAGATION

The papaya is usually propagated by seeds. Vegetative propagation by grafting, inarching, and cuttings can be done also but it is very rarely tried.

The first is the most common method employed everywhere. Its chief disadvantages, however, are that the fruits very often do not come true to type and the percentage of male plants ranges from 5 to 20 per cent.

The second method is the most practical way of asexual propagation. It is rather hard of performance and requires good practice in the art in order to get a good per cent of success. Either male or female seedlings and small branches from old papaya trees should be provided for grafting. This is done only for scientific reasons, that is, when it is desired to preserve the purity of strain of a particular tree producing many big fruits of good quality.

The third method consists of cutting away a small part of a branch of the scion and the trunk of the stock and then bringing them together and holding them firmly by tying them with string or tape. When they unite the top of the stock is cut away entirely, while the scion is severed from the mother plant. This method is also quite slow and expensive.

The fourth method involves the cutting of branches into cuttings 30 cm. long and then planting them horizontally in fine sand or fine friable soil under a nursery shed leaving only a small portion above the ground. This is the slowest method of vegetative propagation and the resulting plants are the latest to come into bearing.

The seed-bed for planting the seeds should have black clay loam soil and be well drained. It should be dug up about a foot deep with a spade or spading fork, the clods broken to pieces and the roots, stones, and weeds raked away, to make the surface as level as possible. It should be narrow enough to permit of easy weeding and cultivation on both longitudinal sides. A good size for the bed is 1 meter by 5 meters. It should be higher than the general level of the ground so that it will not be flooded when it rains. A shed of bamboo slats furnishing half shade should be built over the bed so as to keep off the direct rays of the sun which lower the vitality of the seeds. In an experiment on the effect of sunlight on the germination of papaya seeds at the Lamao Experiment Station, Lamao, Bataan, one-half day sunshine from 7 a. m. to 11.30 a. m. and partial shade (under nursery shed) gave the highest per cent of germination of seeds. The results are given in Tables I and II.

TABLE I

No.	Conditions	Percentage of germination
1	Entire shade the whole day without receiving heat of the sun	....
2	Entire shade. The pot was placed in the shade near the edge of the building the whole day so that it received more light than No. 1	14.66
3	Half day sunshine from 7 a. m. to 11.30 a. m	35.66
4	Partial shade in the nursery shed	21.00
5	Entirely exposed in the sunlight the whole day	....

NOTE.—Condition 1 was subjected to condition 3 on May 17, 1923. Fifteen seeds germinated on May 23—5 per cent.

TABLE II

No.	Conditions	Percentage of germination
1	Entire shade the whole day without receiving heat of the sun	1.00
2	Entire shade. The pot was placed in the shade near the edge of the building the whole day so that it received more light than No. 1	2.66
3	Half day sunshine from 7 a. m. to 11.30 a. m	26.66
4	Partial shade in the nursery shed	13.66
5	Entirely exposed in the sunlight the whole day	0

NOTE.—Condition 1 was subjected to condition 3 on July 2, 1923. Twenty-five seeds germinated on July 10—8.33 per cent. Condition 2 was subjected to condition 3 on July 2, 1923. Thirty-two seeds germinated on July 8—10.66 per cent.

The seeds are broadcasted thinly on the surface of the bed and then covered with fine soil as thick as the seeds themselves. About 15 grams of seeds are enough per square meter of the bed. In this way no pricking of the seedlings is necessary as they are far enough apart to allow them to grow until they are transplanted to the field. As papaya seeds do not give a very high percentage of germination, a certain amount should be saved to sow in place of those which do not germinate and for replanting purposes generally. Estimating the spacing of the trees as 3 meters by 3 meters apart and taking into consideration the above facts, from 30 to 40 grams of seeds are required to plant a hectare of ground.

If, however, the seeds are planted thickly, another bed should be provided for pricking the seedlings into when two or three true leaves have appeared so as to prevent them from becoming leggy and slender. They should be dug up after a thorough watering and set out from 7 to 10 centimeters apart.

The seeds may be planted a month before transplanting time so as to allow them to grow big enough for planting at the beginning of the rainy season.

Thorough watering should be done when the soil appears dry. The plants should not be watered very often as that would induce the growth and spread of damping-off fungi. Rain-proof sheds should be provided so as to keep off excess of water, which is detrimental to the seedlings.

If they become yellowish green in color or stunted or if it is desired to grow them extra fast, compost or fine-rotted manure should be broadcasted from time to time. Ammonium sulphate, sodium nitrate and dried blood can be used to advantage. These fertilizers should be spread very thinly on the surface of the ground and should not be allowed to lodge on the leaves as they would burn them. The broadcasting should be followed with a good watering to hasten the dissolution of the fertilizers and to remove the particles which may be deposited on the leaves.

SELECTION OF THE LAND

In selecting the land intended for planting papaya, the following points should be considered: Appearance and character of the soil, supply of water, drainage, nature of the present vegetation, exposure to sun and wind, transportation facilities and distance from the market.

PREPARATION OF THE LAND

All vegetation on land overgrown with small trees and shrubs should be cut down close to the ground during the dry season and then burnt when it becomes dry. The land should be free from stumps and should be plowed and harrowed several times making it as level as possible before planting to papaya. Cogon land should not be selected or if used should be first planted thickly to a cover crop, *Tephrosia candida* for example, in order to kill the cogon.

TRANSPLANTING TO THE FIELD

Prior to transplanting, the field should be measured and stakes driven in to make the permanent places for the plants. They should be set out from 3 to 4 meters apart.

Several days prior to transplanting the seedlings should be hardened off so as to make them strong enough to resist field conditions. That is they should be accustomed to the direct heat of the sun gradually by removing the shed until they can be left the whole day under the sun without wilting.

Seedlings from 15 to 20 centimeters tall are ready for transplanting. This is done at the beginning of the rainy season so as to give them a good start before the dry season comes and to save watering and shading when planted in the latter.

Before the seedlings are removed from the seed-bed, the leaves should be trimmed off at the tip of the leaf petiole thus leaving only the latter on the plant. A thorough watering is necessary so the plants can be dug up easily without destroying many of the roots and to make the soil adhere to the root systems. The latter should be covered with wet gunny sacks to prevent them from drying out due to wind or the heat of the sun. The holes should be dug wide and deep enough to accommodate the root systems in their natural position. The plants should be set as deep as they were in the nursery bed and the soil should either be made level or higher at the base of the plants so that too much water which would cause the root systems to rot will not accumulate.

A study of the root systems and general characteristics of seedlings to determine the sex so as not to plant male plants has been made at the Lamao Experiment Station, Lamao, Bataan, but it was found out that the sex could not be determined. This contradicts the belief of some farmers that the root system has a relationship to the sex. It was hinted also by some that the seeds from the base of the fruit have more per cent of male seedlings than the other parts. An experiment to determine this was also undertaken. A good sized ripe fruit was obtained and divided into 3 parts, tip, middle, and butt. The seeds in each part were planted seperately and the per cent of maleness determined. The results given in Tables III and IV are as follows:

1. Variety	Hawaiian papaya.
2. Date planted	March 15, 1924.
3. Date germinated	March 26, 1924.
4. Date pricked	March 29, 1924.
5. Date transplanted	May 28, 1924.
6. Date of flowering	October 8–20, 1924.

TABLE III

Parts of the fruit	Number of plants set out	Number of male plants	Number of female plants	Per cent of male plants	Remarks
Tip	60	8	52	13.33	The plants were planted 1 meter by .5 meter so as to permit them to flower and then they were cut down.
Middle	95	15	80	15.78	
Butt	70	5	65	7.14	

1. Variety	Hawaiian papaya.
2. Date planted	March 2, 1925.
3. Date germinated	March 18, 1925.
4. Date transplanted	May 27, 1925.
5. Date of flowering	September 5–26, 1925.

TABLE IV

Parts of the fruit	Number of plants set out	Number of male plants	Number of female plants	Per cent of male plants	Remarks
Tip	46	17	29	36.95	The plants were set out 1 meter by .5 meter so as to allow them to flower only.
Middle	120	24	96	20.00	
Butt	30	12	18	40.00	

From the above tables it can be seen that maleness occurred in seeds from all parts of the fruit and that the respective percentages of maleness were variable. Seeds for planting, therefore, can be taken from any part of the fruit.

PLANTATION MANAGEMENT

Cultivation and weeding.—The plantation should be kept free of weeds. An animal-drawn cultivator can be used to weed the spaces between the rows of plants and a garden hoe to weed and cultivate the spaces around the trunks about two meters in diameter.

Cultivation should be done a few days after a rain when the soil is friable so as to conserve the soil moisture. In cultivating around the plants care should be taken not to injure the trunks and roots.

Irrigation and drainage.—In places where the dry season is quite long and distinct, as in Bataan, irrigation is necessary so as to prevent wilting and to make the trees fruit continuously throughout the year This can be done twice a month by flooding or by a canal system, depending of course on the contour of the ground. In the former case the water is just allowed to run in sufficient quantities to render the plantation thoroughly wet. The second system is employed for land with an even surface. The canals to be made should be far away from the trees and they should not be so deep as to destroy the roots of the plants.

The papaya is very sensitive to standing water, so that drainage is an important factor in its culture. All excess water accumulated during a rain should be drained off by making a canal or canals.

Cover cropping.—The spaces between the rows of plants while the latter are still small can be planted to some small herbaceous cover crops like cowpeas, mongo, and soy beans. They should not be planted too close to the papaya plants as this would prevent the latter's rapid development thereby making them slender and sickly and delaying the fruiting.

When the papaya plants become big, the growing of other crops is detrimental because papaya trees have very shallow root systems, which may be destroyed in plowing the ground. Cover crops will not grow well under the shade of papayas anyway.

Fertilization.—In a new plantation, fertilization is practically not necessary, as the soil is rich enough to give the plants all the food elements required. However, if the vegetative portions of the normal trees become yellowish green in color, nitrogenous fertilizers like ammonium sulphate, sodium nitrate and dried blood may be applied at the rate of from .5 to 1.0 kilo per tree about one year old. These should be broadcasted around the trunk, within a radius of two meters in diameter and then mixed thoroughly with the soil.

Grafting.—Only the desirable trees are allowed to grow in the plantation while the undesirable ones, such as the male plants and those producing undersized fruits should either be replaced by new seedlings or grafted, using scions from old trees producing many big fruits of good quality. The first method is rather slow and uncertain. The plantation would not have a good stand and the sex of the seedlings used for replanting would not be known so that in case they turn to be male also, replanting would be necessary. The second method therefore is more practicable than the former provided that materials for the manipulation are available. The good stand of the plantation is maintained and the good qualities of the scions are sure to be obtained.

Old papaya trees may be induced to produce many branches for scions by being cut down to from one to two meters above the ground. These scions are used in cleft grafts protected with banana leaf sheaths in order to prevent the entrance of water and rapid drying out due to heat of the sun before union takes place. In the cleft grafting of the papaya, two scions may be inserted into two edges of the cut surface of the stock and string or any like material or tape may be used for tying (see figure 6). Grafting can be done at any time of the year but more success can be obtained during the rainy season because the scions do not dry off easily and so a more rapid union of the stock and scion results than in the dry season. Care should be exercised to prevent the entrance of water to the wound. The scions are cut from 10 to 15 cm. long and all petioles cut close and covered entirely with banana leaf sheaths.

Thinning of fruits.—There are good trees among those in the plantation which produce small and irregular fruits aside from the big ones. Some of them bear too many fruits, which prevents the other fruits from reaching their natural size. All the small and undersized fruits should be removed while still green so as to give place for development to the desirable fruits and to make the remaining fruits on the tree increase in size. An experiment of this nature was undertaken at the Lamao Experiment Station and the thinning of fruits resulted in an increase in size of the remaining green fruits in the tree. The results are given in Tables V and VI.

TABLE V

Tree No.	Stage of fruit	Length			Diameter			Weight		
		Removal of small fruits		Difference	Removal of small fruits		Difference	Removal of small fruits		Difference
		Before	After		Before	After		Before	After	
		Cm.	*Cm.*	*Cm.*	*Cm.*	*Cm.*	*Cm.*	*Kilos*	*Kilos*	*Kilos*
1...	Largest	12.0	12.0	......	9.2	9.3	.1	.64	.68	.04
	Average	11.2	11.6	.4	9.1	9.5	.4	.48	.75	.27
	Smallest	9.1	9.1	.0	7.5	7.6	.1	.24	.28	.04
2...	Largest	12.4	12.6	.2	10.5	10.7	.2	.85	1.4	.55
	Average	11.4	11.5	.1	9.4	9.8	.4	.65	.75	.11
	Smallest	10.4	10.7	.3	7.2	7.3	.1	.32	.46	.14
3...	Largest	15.5	15.5	.0	10.1	10.4	.3	.8	1.0	.2
	Average	12.0	12.1	.1	9.9	10.1	.2	.54	.65	.11
	Smallest	7.4	7.5	.1	4.6	4.4	—.2	.18	.20	.02

NOTE.—Initial description was made on September 18, 1923. Last description was made on April 23, 1924.

TABLE VI

Tree No.	Stage of fruit	Length			Diameter			Weight		
		Removal of small fruits		Difference	Removal of small fruits		Difference	Removal of small fruits		Difference
		Before	After		Before	After		Before	After	
		Cm.	*Cm.*	*Cm.*	*Cm.*	*Cm.*	*Cm.*	*Kilos*	*Kilos*	*Kilos*
1...	Largest	18.0	17.0	—1.0	14.0	14.0	.0	.85	.8	.05
	Average	15.1	15.2	.1	13.6	13.4	—.2	.6	.6	.0
	Smallest	9.5	9.7	.2	7.8	7.9	.1	.48	.50	.2
2...	Largest	21.0	19.5	—1.5	15.8	14.9	—.9	.95	.9	—.05
	Average	16.3	15.7	— .6	13.5	13.9	.4	.7	.8	.1
	Smallest	10.4	11.3	.9	8.2	8.6	.4	.62	7.6	.14
3...	Largest	18.0	20.6	2.6	14.0	16.3	2.3	.85	1.2	3.5
	Average	15.1	15.9	.8	13.4	13.4	.0	.60	.75	.15
	Smallest	9.5	10.7	1.2	7.8	8.6	.8	.48	.70	.22

NOTE.—Initial description was made on February 5, 1925. Last description was made on October 1, 1925.

HARVESTING

Papayas may be harvested either as papain, or as ripe or matured or green fruits depending of course on the demand and price in the market and the margin of profit to the grower.

As papain.—Papain is a compound found in the milky juice of the fruits and other parts of a papaya plant used as remedy for dyspepsia or to help digest the food, clarify beer, make meat tender before and during cooking, and to clean clothes.

It can be obtained by making incisions in the green fruits with a sharp pointed bamboo or bone and collecting the juice in a porcelain or glass dish. Iron utensils should not be used in its extraction as a chemical reaction will take place which will destroy the value of the papain. In order to get the maximum amount of latex, extraction should be done from early in the morning to about noon. During this time the plant is quite active in sending the manufactured food into the fruits and other parts. The latex is dried and sold in this form as papain. An experiment on the best time of the day when to extract the juice of Hawaiian papaya at intervals of one and two days has been performed at the Lamao Experiment Station, Lamao, Bataan, and the results are given in Tables VII, VIII, and IX.

TABLE VII

Date extracted	Tree No. 1			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
May 5, 1925	7 a. m.	22	18	.818
May 7, 1925	do.	21	12	.571
May 9, 1925	do.	20	7	.35

TABLE VII—Continued

Date extracted	Tree No. 2			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
May 5, 1925	10 a. m.	10	11	1.1
May 7, 1925	do.	9	6	.666
May 9, 1925	do.	7	3.5	.50

Date extracted	Tree No. 3			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
May 5, 1925	1 p. m.	10	6	.6
May 7, 1925	do.	10	4	.4
May 9, 1925	do.	10	2	.2

Date extracted	Tree No. 4			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
May 5, 1925	4 p. m.	29	12	.413
May 7, 1925	do.	26	8	.307
May 9, 1925	do.	26	6	.23

TABLE VIII

Date extracted	Tree No. 1			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
November 12, 1927	7 a. m.	10	2.5	.25
November 14, 1927	do.	9	.5	.055
November 16, 1927	do.	3	.5	.16

Date extracted	Tree No. 2			
	Time extracted	Number of fruits tapped	Weight of papair extracted	Average weigt of papain per fruit
			Grams	*Grams*
November 12, 1927	10 a. m.	18	2.25	.12
November 14, 1927	do.	15	1.25	.083
November 16, 1927	do.	12	.75	.062

TABLE VIII—Continued

Date extracted	Tree No. 3			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
November 12, 1927	1 p. m.	10	1.5	.15
November 14, 1927	do.	10	1.5	.15
November 16, 1927	do.	10	1.25	.125

Date extracted	Tree No. 4			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
November 12, 1927	4 p. m.	12	1.75	.14
November 14, 1927	do.	12	2.00	.16
November 16, 1927	do.	11	.25	.022

NOTE.—No extraction was made on November 8, 1927, at 4 p. m. because it was raining.

TABLE IX

Date extracted	Tree No. 1			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
November 7, 1927	7 a. m.	10	4.5	.45
November 8, 1927	do.	10	2.75	.275
November 9, 1927	do.	10	1.5	.15

Date extracted	Tree No. 2			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
November 7, 1927	10 a. m.	18	5.0	.27
November 8, 1927	do.	18	2.5	.13
November 9, 1927	do.	18	1.75	.097

Date extracted	Tree No. 3			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
November 7, 1927	1 p. m.	10	.40	.4
November 8, 1927	do.	10	.75	.075
November 9, 1927	do.	10	1.0	.1

TABLE IX—Continued

Date extracted	Tree No. 4			
	Time extracted	Number of fruits tapped	Weight of papain extracted	Average weight of papain per fruit
			Grams	*Grams*
November 7, 1927	4 p. m.	13	2.0	.15
November 8, 1927	do.	....	....	....
November 9, 1927	do.	12	.5	.041

NOTE.—No extraction was made on November 8, 1927, at 4 p. m. because it was raining.

As fresh fruits.—Ripe and matured fruits are harvested for the table. They can be made also into sauce, jelly, pie, preserves, pickles, salad, and ice cream. If the fruits are to be sent to the market, they should be harvested when the surface begins to turn yellow or when the latex becomes light. They are then placed upside down in an open container (with straw or dry banana leaf) with a capacity of from ten to fifteen fruits.

Harvesting can be done easily when the plants are low but when they become high, the picking of fruits becomes hard. They should not be allowed to drop to the ground or injured in any way as they would rot easily. With tall trees, the fruits may be harvested with a bamboo pole one end of which is split and formed into a sort of basket or container where the fruits are lodged.

Green fruits may also be harvested for making pickles or they may be eaten as a vegetable with fish or meat.

YIELD

Ripe fruits may be obtained from the plants in nine to ten months from transplanting in their permanent places. They produce fruits throughout the year. Many fruits ripen in the early part of the dry season but become fewer as the season advances. If the latter is too long, the plants stop bearing fruits and commence fruiting again when the rainy season comes. The most productive stage of the tree, when big fruits are produced, is its first two years of existence. After this it degenerates, producing small fruits as it grows higher.

Different varieties and even different plants in a variety differ in their capacity to produce fruits. The four main varieties planted at the Lamao Experiment Station, Lamao, Bataan gave yields in two years from 15 to 108 fruits for the Hawaiian Rounded, from 35 to 74 fruits for the Hawaiian Pointed, from 68 to 89 fruits for the Round Solo, and from 7 to 49 fruits for the Long variety. The rates of production in detail are given in Table X and summarized in Table XI.

TABLE X

Tree No.	Variety name	Age in years	Actual yield in fruits
1	Hawaiian Rounded	2	98
2	do	2	15
3	do	2	29
4	do	2	43
5	do	2	39
6	do	2	108
7	do	2	28
8	do	2	81
9	do	2	105
10	do	2	98
11	do	2	57
12	do	2	72
13	do	2	105
1	Hawaiian Pointed	2	61
2	do	2	53
3	do	2	74
4	do	2	35
1	Round Solo	2	68
2	do	2	72
3	do	2	79
1	Long	2	11
2	do	2	27
3	do	2	16
4	do	2	24
5	do	2	7
6	do	2	45
7	do	2	49

TABLE XI

No.	Variety name	Age in years	Number of bearing trees	Yield in number of fruits			Rank	Description of fruits
				Actual	Average	Per hectare		
1	Hawaiian Rounded	2	13	878	67	74,437	2	Big, rounded at tip, big seed cavity, seedy, thin flesh of fine texture and sweet.
2	Hawaiian Pointed	2	4	223	55	61,105	3	Big, pointed at tip, big seed cavity, few seeds, thin flesh of fine texture, rather watery and not so sweet as the Hawaiian Rounded.
3	Round Solo	2	3	219	73	81,103	1	Small, rounded at tip, big seed cavity, very seedy, thin flesh of fine texture and very sweet.
4	Long	2	7	179	25	27,775	4	Long, either rounded or pointed at tip, small seed cavity, few seeds, thick flesh of fine texture, rather watery and very often not sweet.

NOTE.—The computation per hectare was based on trees planted 3 meters by 4 meters.

SEED SELECTION

Seeds for planting should be selected from big ripe fruits of good quality with a small seed cavity and few seeds, from a productive tree. Preference should be given to a hermaphrodite papaya as the seeds from this type are most likely to reproduce true to type, because the stigma has been fertilized with pollen from the same plant.

The seeds should be washed thoroughly to remove the pulp and watery substance and then dried in a shady, well-ventilated place. Then they should be placed in air-tight bottles and stored in a cool place for the next planting season. Experiments on the different methods of preparing seeds in order to get the highest per cent of germination have been performed at the Lamao Experiment Station, and the following results in Tables XII and XIII were obtained:

TABLE XII

No.	Conditions	Percentage of germination
1	Without washing and removing the pulp and watery substance and planting right away	54.5
2	After removing the watery substance and washing and planting right away	63.7
3	Without removing the pulp and watery substance and then dried in the sun	42.9
4	Without removing the pulp and watery substance and then dried in a well ventilated shady place	46.8
5	After removing the pulp and watery substance and washing and then drying in a well ventilated shady place	80.4
6	After removing the pulp and watery substance and washing and then drying in the sun	78.5

TABLE XIII

No.	Conditions	Percentage of germination
1	Without washing and removing the pulp and watery substance and planting right away	76.2
2	After removing the watery substance and washing and planting right away	37.2
3	Without removing the pulp and watery substance and then drying in the sun	56.4
4	Without removing the pulp and watery substance and then drying in a well ventilated shady place	67.4
5	After removing the pulp and watery substance and washing and then drying in a well ventilated shady place	63.0
6	After removing the pulp and watery substance and washing and then drying in the sun	34.8

REJUVENATION

Papaya trees in general after the second year are quite tall, and the fruits produced are undersized. Such trees may be rejuvenated or made to grow vigorously and produce big fruits by cutting them down to from one half to one meter above the ground. In a month or two from the cutting, many branches will appear from the trunk. Only one or two healthy branches should be allowed to develop, preferably on opposite sides of the trunk so as to produce big fruits.

DISEASES AND PESTS

So far no diseases which require attention have been noted on papaya plants in the field. But the damping-off fungus which does great injury to seedlings of other crops planted in seed flats or seed-beds attacks papaya seedlings also. The first symptom of the disease is the slightly sunken watery spot on the trunk near the surface of the ground and the slightly yellowish-green foliage. The affected part rots in the latter stage, causing the seedlings to fall. The means of prevention are to plant the seeds in a new uninfected soil, to remove the seedlings from an infected seed-bed and prick them to a new one, to plant thinly, not to give frequent slight waterings, and to expose the seedlings gradually to the sun.

An agricultural chemical consisting of 30 per cent hydroxymercurichlorophenol sulphate and 70 per cent inert material for the control of damping-off of seedlings has been tried recently at this station and the results so far obtained are encouraging. The seed-flats containing the seedlings affected with the damping-off fungus were drenched with the solution of one ounce of the material to three gallons of water every time the soil appeared dry until the attack had ceased. It was found that the seedlings affected with the damping-off decreased materially from the third to the fifth drenching of the solution.

With the exception of crows, and the grubs of the "toy-beetle" (*salagubang*) which at times kill some plants by feeding on the roots no other pest of importance have so far become destructive to the papaya as to require a close supervision.

Although a relatively few diseases and pests attack the papaya it is necessary that strict sanitation be practiced in a plantation in order to prevent the attack of these and other diseases and pests that are as yet unknown or unreported.

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THE NATURAL STORAGE AND CURING OF BATANGAS MANDARIN ORANGES (*CITRUS NOBILIS* LOUR.,) IN AN UNDERGROUND CEMENT CHAMBER

By JOSE DE LEON
Superintendent, Tanauan Citrus Experiment Station

Most varieties of citrus fruits mature in a comparatively short time. This causes their being "dumped" on the market at certain times of the year, which results in unprofitable returns to the producers. Moreover, soon after their respective seasons, they disappear from the market, and the consumer has to go without them until their next fruiting seasons. It is also well known that citrus fruits grown in the Tropics ripen on the tree without attaining that attractive yellowish or reddish orange color which characterizes those grown in the milder climates, although they may have just as good eating qualities as the latter. An economical means of keeping such fruits to improve their appearance, and at the same time allowing them to be marketed for a longer period of time than would otherwise be possible, would, therefore, be desirable.

The Tanauan Citrus Experiment Station, at Tanauan, Batangas Province, Philippines, constructed, in 1920, an underground chamber for the storage and curing of mandarin oranges, this being the principal citrus crop in the Province of Batangas. This earthen type of chamber was indeed very cheap as very little material was added to the natural earthen ceiling, floor and walls to adapt it for the storage of the oranges. This, however, had serious disadvantages, which are believed to preclude this type of chamber for commercial purposes. The atmospheric humidity in such a chamber, becomes, at times, too high for best storage results. The structure does not last long because, after a rapid deterioration of the wooden parts supporting the ceiling, the top soon collapses during a heavy rain. The results of storage experiments in such a chamber, however, were such as to encourage further work along that line. Therefore, a reinforced cement underground chamber for the storage and curing of Batangas mandarin oranges and other citrus fruits was constructed in September, 1923. This has proved to be a great improvement over the former type of chamber. Its construction is herewith described.

An elevated piece of ground about 10 feet high, and shaded the greater part of the afternoon by a large mango tree, was selected as a site for the underground chamber. East of this elevation is a first class provincial road, the construction of which made the eastern side of the elevation almost vertical for about 10 feet. As the wind comes from that direction the greater part of the year, the door of the chamber was located on that side to facilitate the free movement of air.

The main parts are the walls, the ceiling and the air current spreader or diffuser, which is a structure, just behind the door, to shield the fruits stored behind it, from being strongly hit by the currents of air coming from outside the chamber. This also serves to diffuse the air currents before their passage through the storage room so that a more uniform aëration of the fruits may be brought about.

In starting the construction of the chamber, the excavation of earth proceeded from the surface of the mound downward, following closely the outsie dimensions of the chamber as planned. Having completed it down to the level of the storage floor, the excavation of the earth then went on in the spaces for the paths toward the door.

The cement walls enclosing the chamber were molded by placing boards 8 inches distant from the mounds of earth outside, then scattering barbed wire pieces for reinforcement at regular intervals within the mold, and then pouring on the cement mixture.

After completing the construction of the walls to the desired height, 79 inches, the air current diffuser (see Fig. 1) was next built. This structure is located just behind the door and has the same height as the walls.

The ceiling of the chamber supports a heavy load of earth. It was therefore made especially strong by the use of a richer mixture of cement than that used for the walls, reinforced with three-fourths inch steel rods placed about 12 inches apart, and as further aid in strengthening it, it was made concave on the underside. Its thickness is 8 inches. To make it as watertight as possible, a thick coating of cement and sand was put on the upper surface.

Two sets of shelves, as shown in Figure 1, are built inside the storage chamber. Each set contains 7 shelves, one above the other (Fig. 2). The shelves along the hindmost part of the storage room measure, each, 25 inches by 144 inches, while in the opposite set, the shelves measure 25 inches by 78 inches. The capacity of all the shelves runs from 4,500 to 9,000 oranges, depending upon whether one or two layers are placed on each shelf.

The framework of the shelves is made up of 2 inches by 2 inches boards for the posts, and 1 inch by 2 inches pieces for the lateral supports. For shelf flooring bamboo pieces 1 inch by 25 inches are used. These are nailed on the lateral boards 1 inch apart. The distance of each shelf from the one above or below it is 7⅝ inches. The front side of each shelf was made one inch higher than the rear side, to prevent fruits from rolling off and falling to the ground.

All the lumber used as permanent parts of the chamber is of the termite-proof group, as otherwise termites would quickly attack those parts. As a precaution against the rapid deterioration of the bamboo pieces, only well-seasoned bamboo was used, and the pieces were immersed in a 0.2 per cent solution of mercuric bichloride for 1 hour before being used. The cement interior of the chamber was whitewashed, and the bamboo and wooden parts were painted with white lead. The ventilating chimneys were coated with a thick asphaltum paint.

THE COOLING MECHANISM OF THE UNDERGROUND CHAMBER

The cooling mechanism of the storage chamber consists of the door, the three ventilating chimneys, and the floor. The earthen layer that surrounds the whole structure also acts as an insulator, to help prevent the rapid changes of temperature of the outside air from greatly affecting the air conditions inside the chamber.

There is an outer and an inner door. The inner door is covered with No. 16, 4-mesh to the inch, woven wire. The outer door, made of framed No. 24 galvanized iron sheeting, shuts in over the woven wire door.

During the period of fruit storage the outer door is opened at night to allow the cool air to run through the chamber. During the day this door is closed to keep the hot air outside from getting in. Thus the cool temperature of the air gained during the night is largely preserved during the day.

The ventilating chimneys are made of No. 24 galvanized iron cylinders, 6¼ inches in diameter, and 38 inches long. They are placed in holes provided for them along the middle of the ceiling, at equal distances of 3 feet from the walls and from each other (Fig. 2).

The function of these chimneys is to allow the exit of the air current from the door, after its passage through the storage chamber.

The floor is earthen, surfaced with sand. As earth is a good conductor of moisture, and as it easily gives up moisture, it is of help in reducing the temperature, and increasing the humidity of the air inside the chamber. On hot, dry days, a considerable reduction of the temperature and increase in the relative humidity of the air inside the chamber may be brought about by merely sprinkling the floor of the chamber with water, during the evening. These effects tend to improve the storage conditions within the chamber.

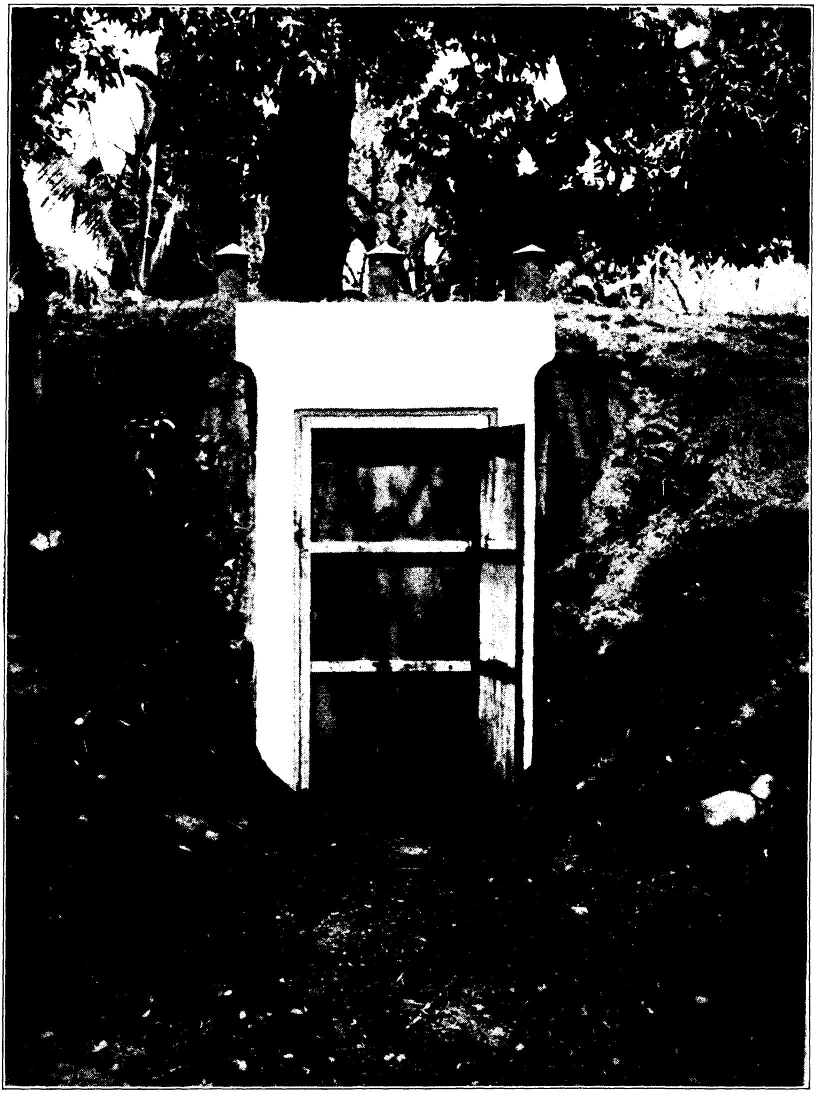
THE USE OF THE UNDERGROUND STORAGE CHAMBER

No refrigeration or artificial cooling down of the temperature by the use of ice has been resorted to in the storage of mandarins. However, in localities where citrus fruit production is not carried on on an extensive commercial scale, with near-by markets ready to absorb the product, which can be turned out two or three months after its season has passed, this type of natural storage would very likely be satisfactory.

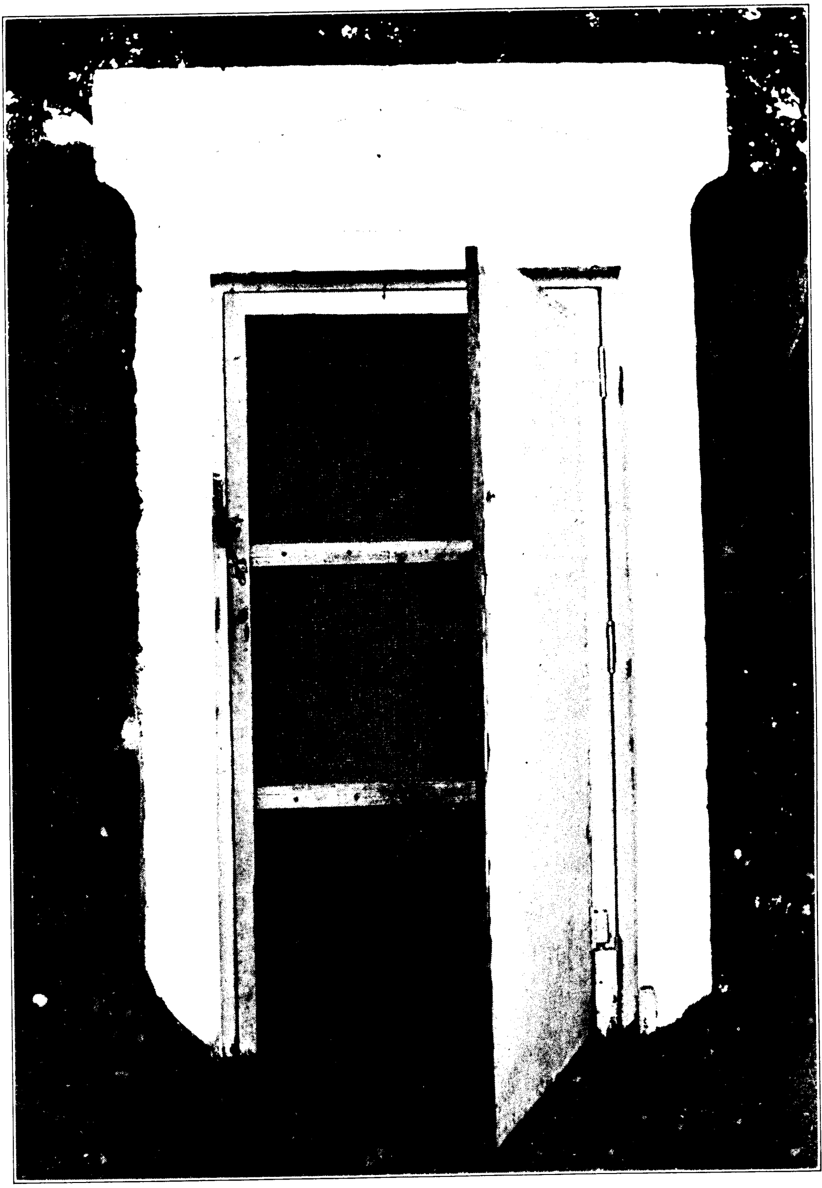
The use of the above-described underground chamber presents some important advantages. Its initial cost is comparatively small. It is estimated that at the current (1929) prices of materials in the Philippines, the cost of building an underground chamber of the size described in this article would not exceed ₱300, including the cost of labor. A storage chamber having twice or three times the capacity of this chamber would be more suitable for commercial storage purposes and, at the same time, would cost proportionately much less per square foot of storage space.

The upkeep of the storage chamber when in operation costs nothing except for the labor required in its operation. Considering the fact that it is almost entirely made of cement, the life of such a chamber is indefinite. If termite-proof lumber is used for its wooden parts, practically no repairs need be made for years.

As mandarin oranges, depending upon their variety, may be kept in good condition in this chamber for from one to five months, the prospect of making a considerable margin of profit in their storage is good.



Outside view of the underground storage chamber, showing the door and the ventilating chimneys



The double door of the underground storage chamber, showing the wire screen door closed and the galvanized iron door partly open

In the storage of mandarin oranges in this chamber, the following rules have been observed:

1. Only sound and well-matured fruits are selected for storage.

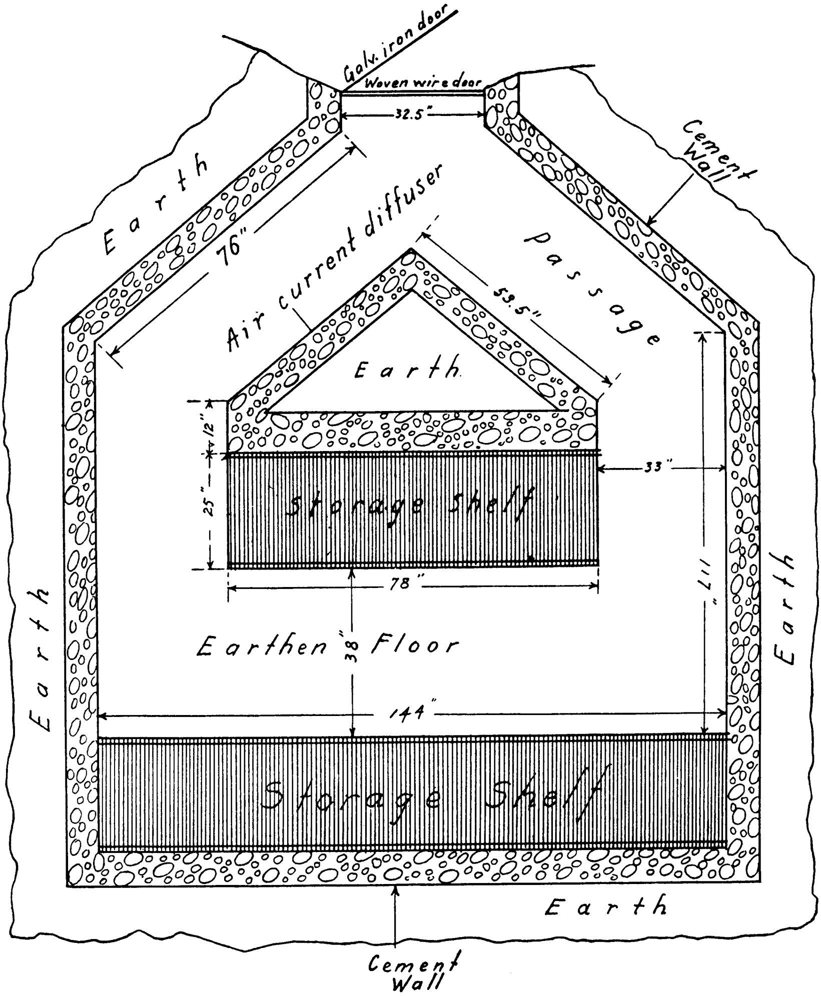


FIG. 1. Lower cross section of the underground storage chamber as viewed from the top.

2. A weekly or biweekly inspection of the fruits is made to remove the decaying fruits.

3. During the entire period of storage, the galvanized iron door is opened at night to allow the cool air to run through the

chamber, and closed during the day to keep the hot air outside from entering.

4. When storage is carried on during the hot season, water on the floor is sprinkled daily, as a further means of cooling down and humidifying the air inside the chamber.

5. The fruits are placed on the shelves thinly, i.e., in one or two layers only.

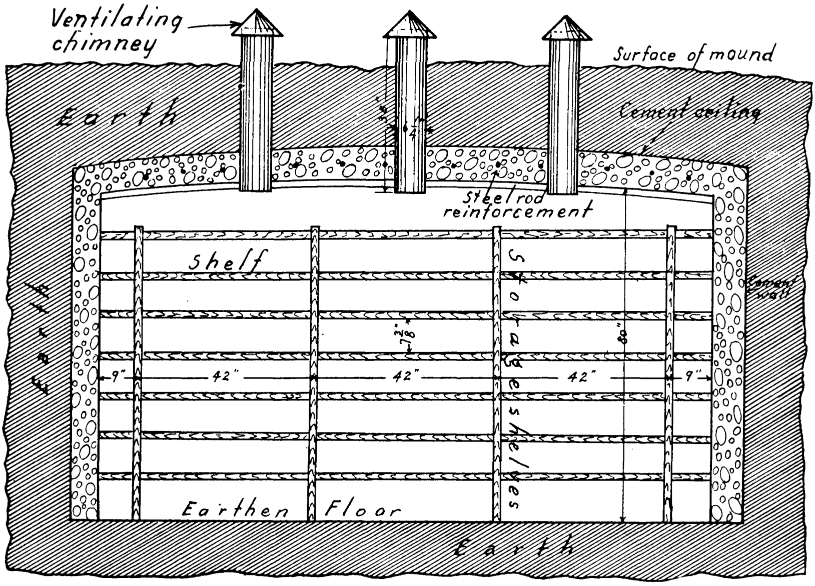


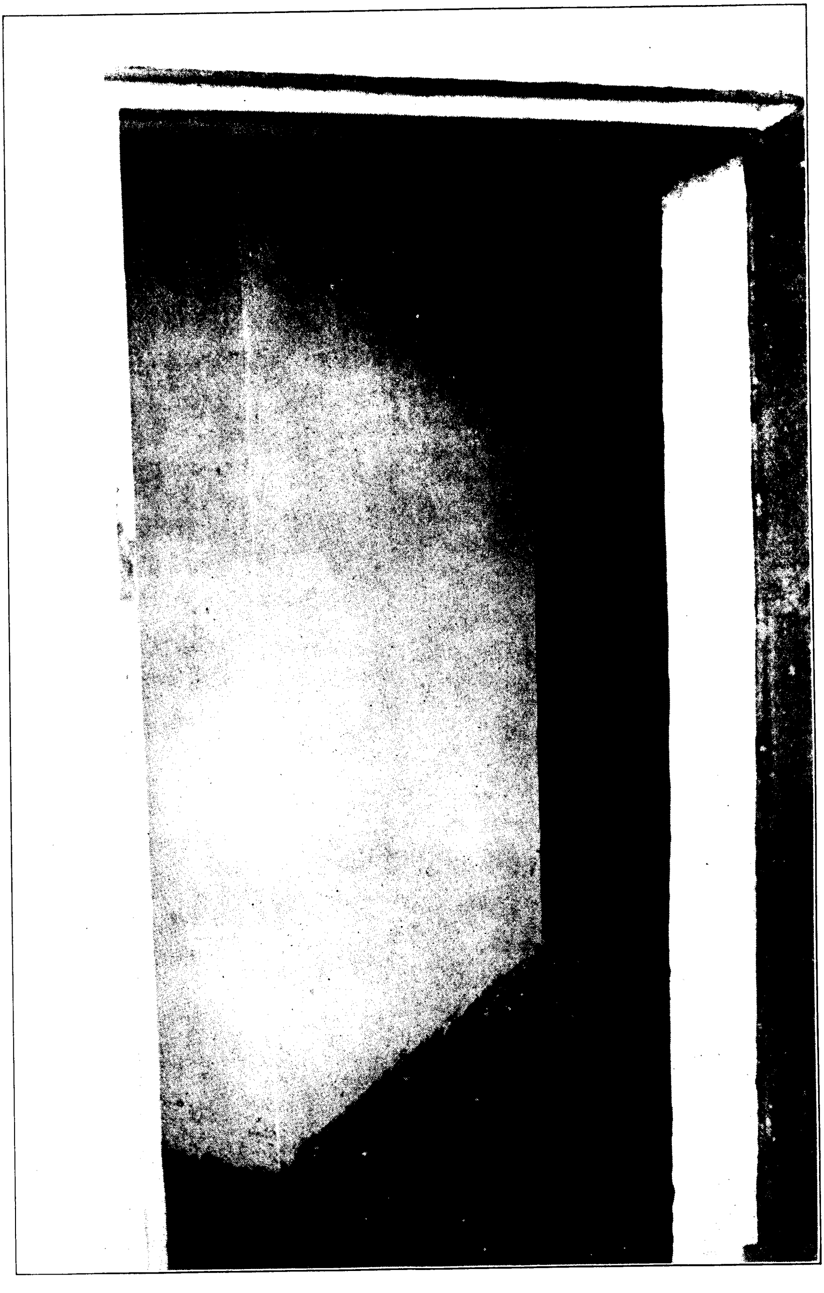
FIG. 2. Rear cross section of the underground storage chamber as viewed from the front.

RESULTS OF STORAGE EXPERIMENTS

The results of experiments conducted in 1924 and 1925 at the Tanauan Citrus Experiment Station on the storage of Batangas mandarin oranges are shown in Table I.

TABLE I

Treatment of fruit	Date placed in storage	Number	Fruit decayed			
			First week		Second week	
			Number	Per cent	Number	Per cent
Untreated fruits	January 14, 1924	190	0	0	2	1.1
Untreated fruits	February 7, 1925	540	3	0.5	6	1.1
Immersed for 5 minutes in 0.02 per cent potassium permanganate solution.	January 14, 1924	190	0	0	1	0.5
Immersed for 5 minutes in 0.018 per cent potassium permanganate solution.	January 24, 1925	347	1	0.3	3	0.9
	January 31, 1925	369	1	0.3	7	1.9
Immersed for 5 minutes in 0.2 per cent formalin solution.	January 14, 1924	190	0	0	0	0



The air current spreader shown just behind the door opening

TABLE I—Continued

Treatment of fruit	Date placed in storage	Number	Fruit decayed															
			Third week		Fourth week		Fifth week		Sixth week		Seventh week		Eighth week		Ninth week		Tenth week	
			Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Untreated fruits	January 14, 1924.	190	2	1.1	2	1.1	5	2.6	22	11.6	32	16.8	57	30.0	80	42.1	96	50.5
Untreated fruits	February 7, 1925.	540	12	2.2	20	3.7	60	11.1	95	17.5	130	24.1	198	36.7	253	46.9	307	56.9
Immersed for 5 minutes in 0.02 per cent potassium permanganate solution.	January 14, 1924.	190	1	0.5	2	1.1	4	2.1	24	12.6	36	18.9	77	40.5	106	55.8	123	64.7
Immersed for 5 minutes in 0.018 per cent potassium permanganate solution.	January 24, 1925.	347	19	5.5	34	9.8	65	18.7	111	32.0	176	50.7	219	63.1	261	78.1	281	81.0
	January 31, 1925.	369	12	3.3	12	3.3	23	6.2	54	14.6	98	26.6	145	39.3	204	55.3	237	64.2
Immersed for 5 minutes in 0.2 per cent formalin solution.	January 14, 1924.	190	0	0	1	0.5	7	3.7	36	18.9	55	28.9	91	47.9	118	62.1	127	66.8

It will be seen from the foregoing table that under the conditions of the experiments carried on in 1924 and 1925, the untreated fruits generally kept better than those treated with disinfecting solutions of either potassium permanganate or formalin; that the length of time in which the untreated Batangas mandarin oranges could be stored profitably may be considered to be 7 weeks, when the percentages of decay varied from 16.8 per cent to 24.1 per cent.

During the second week of storage, the mandarin oranges attained a reddish orange color, and they noticeably improved in flavor.

A study of the shrinkages of mandarin oranges was carried on during the months of January and February, 1924. Two lots of 6 fruits each were used. One lot was placed inside the underground chamber, and the other on shelves in the office of the Station.

Table II gives the shrinkages in the weights of mandarin oranges stored in the cement underground chamber and in the open air in the Station office.

TABLE II.—*Shrinkage in weight of mandarin oranges stored in a cement underground chamber and in the open air in the house. Tanauan Citrus Experiment Station, Tanauan, Batangas.*

Place of storage	No. of fruits	Original weight	After first week		After second week	
			Weight	Shrinkage	Weight	Shrinkage
		Grams	*Grams*	*Per cent*	*Grams*	*Per cent*
Underground storage chamber, January 7, 1924	1	140	140	0	140	0
	2	170	170	0	165	2.9
	3	150	150	0	145	3.0
	4	160	160	0	150	6.0
	5	180	180	0	180	0
	6	170	170	0	165	2.9
Totals		970	970	0	945	2.5
In shelves in the office, January 7, 1924	7	140	130	7.0	125	10.7
	8	120	120	0	105	12.5
	9	160	150	6.0	(a)	(a)
	10	150	145	3.0	140	6.6
	11	140	130	7.0	(a)	(a)
	12	150	145	3.0	140	6.6
Totals		860	820	4.6	510	8.9

Place of storage	No. of fruit	Original weight	After third week		After fourth week	
			Weight	Shrinkage	Weight	Shrinkage
		Grams	*Grams*	*Per cent*	*Grams*	*Per cent*
Underground storage chamber, January 7, 1924	1	140	140	0	135	3.6
	2	170	165	2.9	160	5.9
	3	150	140	6.7	140	6.7
	4	160	150	6.3	145	9.4
	5	180	180	0	175	2.7
	6	170	165	2.9	165	2.9
Totals		970	940	3.1	920	5.2
In shelves in the office, January 7, 1924	7	140	120	14.3	115	17.8
	8	120	105	12.5	100	16.7
	9	160	(a)	(a)	(a)	(a)
	10	150	135	10.0	135	10.0
	11	140	(a)	(a)	(a)	(a)
	12	150	130	13.3	130	13.3
Totals		860	490	12.5	480	14.3

[a] Decayed.

Partial view of one of the two sets of storage shelves

TABLE II.—*Shrinkage in weight of mandarin oranges stored in a cement underground chamber and in the open air in the house. Tanauan Citrus Experiment Station, Tanauan, Batangas*—Continued.

Place of storage	No. of fruit	Original weight	After fifth week		After sixth week	
			Weight	Shrinkage	Weight	Shrinkage
		Grams	*Grams*	*Per cent*	*Grams*	*Per cent*
Anderground storage chamber, January 7, 1924	1	140	130	7.1	130	7.1
	2	170	160	5.9	160	5.9
	3	150	140	6.7	140	6.7
	4	160	145	9.4	145	9.4
	5	180	170	5.5	165	8.3
	6	170	165	2.9	160	5.8
Totals		970	910	6.2	900	7.2
In shelves in the office, January 7, 1924	7	140	110	21.4	100	28.6
	8	120	95	20.8	([a])	([a])
	9	160	([a])	([a])	([a])	([a])
	10	150	125	16.7	([a])	([a])
	11	140	([a])	([a])	([a])	([a])
	12	150	120	20.0	([a])	([a])
Totals		860	450	19.6	100	28.6

Place of storage	No. of fruit	Original weight	After seventh week	
			Weight	Shrinkage
		Grams	*Grams*	*Per cent*
Underground storage chamber, January 7, 1924	1	140	125	10.7
	2	170	155	8.8
	3	150	130	13.3
	4	160	145	9.4
	5	180	165	8.3
	6	170	155	8.8
Totals		970	875	9.8
In shelves in the office, January 7, 1924	7	140	([a])	([a])
	8	120	([a])	([a])
	9	160	([a])	([a])
	10	150	([a])	([a])
	11	140	([a])	([a])
	12	150	([a])	([a])
Totals		860	([a])	([a])

[a] Decayed.

From the foregoing table it is seen that the losses in the weights of these two lots after 2, 4, and 6 weeks of storage, were 2.5 per cent, 5.2 per cent, and 7.2 per cent, respectively, for the lot stored inside the underground chamber, and 8.9 per cent, 14.3 per cent, and 28.6 per cent, respectively, for the lot stored on shelves in the office of the station.

Considering the fact that the Batangas mandarin orange is a very perishable citrus fruit, the foregoing results of the storage of this fruit may be considered satisfactory. They indicate the possibilities of this type of underground chamber for the economical storage and curing of citrus fruits in general.

PHYSIOLOGY OF STORAGE

Citrus fruits have a better keeping quality when they are fully mature than when they are immature or over-ripe. Immature fruits undergo a more rapid physiological breakdown than do fully matured fruits, while the flesh of over-ripe fruits usually undergo a rapid drying up. There are citrus fruits, notably, the lemon, some varieties of lime and the pummelo, which are unusually good keepers, so that even in their immature stages they keep well for a long period of time.

Citrus fruits, as compared with other fruits, are naturally long keepers, because they have a low rate of respiration. At a temperature of abuot 50° F., they may be held for several months without serious deterioration. At higher temperatures, however, they may also be kept for a longer period than is usually thought possible, provided that the relative humidity of the air can be maintained high enough to prevent a rapid shriveling of the fruits, but at the same time, not so great as to encourage the rapid development of rots which would destroy them.

The temperature and the relative humidity of the air are two very important factors which affect the storage of fruits. The former affects their respiration, and the latter their transpiration. Theoretically, the lowest temperature possible without stopping the respiration of the fruit, is the best storage temperature for that fruit, while the highest relative humidity of the air possible, without unduly encouraging the rapid development of decay is best. However, incidental factors may enter which would offset the effects of these optimum, theoretical conditions.

TEMPERATURE AND RELATIVE HUMIDITY OF THE AIR INSIDE THE UNDERGROUND STORAGE CHAMBER

The average extreme daily temperatures, and the means of the daily relative humidity of the air inside the underground chamber during the months of January, February and March, 1924, are herewith given. In the absence of similar, corresponding data taken locally, in the open air, to serve for comparison, those for Manila are also given. (The data for Manila are taken from "The Climate and Weather of the Philippines, 1903–1918," by Rev. Jose Coronas, S.J., pp. 47, 129.)

	Average daily temperature for—		
	January	February	March
	°C.	°C.	°C.
Underground cement chamber:			
Maximum	23.3	23.5	24.4
Minimum	22.5	22.8	23.5
Range of extreme	0.8	0.7	0.9
Mean of extreme	22.9	23.2	24.0
Manila:			
Maximum	30.3	31.1	32.9
Minimum	20.0	19.9	20.6
Range of extreme	10.3	11.2	12.3
Mean of extreme	25.2	25.5	26.8

	Means of the daily relative humidity of the air for—		
	January	February	March
	Per cent	*Per cent*	*Per cent*
Underground cement chamber	94.6	93.6	93.9
Manila	78.7	73.8	70.8
Difference	15.9	19.8	23.1

The foregoing data as compared with those for Manila, would indicate that the temperature of the air inside the underground chamber is lower, the temperature does not oscillate widely from the extremes, and that the relative humidity is much higher.

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THE FORAGE AND OTHER FIELD CROPS PROJECTS OF THE DIVISION OF PLANT INVESTIGATIONS OF THE BUREAU OF AGRICULTURE

Prepared by M. MANAS Y CRUZ and F. G. GALANG
Of the Division of Plant Investigations

FORAGE CROP PROJECT

Comparative test.—Of the 12 species of forage grasses for soiling tested for three years, the Napier, Merker, Trinidad and Guinea were the best yielders. Their respective yields per hectare were 75.30, 74.60, 40.03, and 33.29 tons of green fodder. Of the paddy forage grasses, the Balili, Bungalon, and Barit gave the best results, with average yields of 58.08, 43.26, and 41.05 tons, respectively, of green fodder per hectare.

Palatability test.—The time of cutting found best to insure palatability was every three months for the Barit, Balili, and Bungalon grasses on poor soil and two months on fertile soil; and every 45 days for the Napier, Merker, Trinidad, and Guinea. It has also been noticed that horses prefer the Barit, Guinea, Para, and Red Top grasses to the other species; to carabaos and cattle the Napier, Merker, Uba cane, Trinidad, Guatemala, Balili, Bungalon, Bayakibok, and *P. setosum* were equally as good as the other species.

Distance of planting test.—Irrespective of the cutting ages, the best distancing for the Napier, Guatemala, Cayenne, Dallis, and Para grasses is 1 by 0.25 meter, the Guinea from 1 by 0.25 to 1 by 0.55 meter, and the Bungalon from 1 by 0.25 to 1 by 0.40 meter.

Adaptability.—The Napier and Merker grasses were drought resistant species. The *Paspalum conjugatum* was found to stand heavy tramping and the Para was capable of withstanding light pasturing. In Baguio, the Kikuyu grass was commended by many people both for forage and for lawn purposes. It is a good grass for grazing being hardy.

Tobacco dust and lime on Barit grass.—To test the practicability of a requirement of the Bureau of Internal Revenue to add at least 20 per cent of lime to tobacco dust whenever this product is employed, an experiment was conducted in 1920. The results showed that while the tobacco dust was inactive, the lime exerted a good influence on the production in direct proportion to the amount applied. The highest yield of cut grass was obtained with an application of 2 metric tons per hectare of a mixture containing 20 per cent of lime and 80 per cent tobacco dust.

Acclimatization test.—Ragi, alfalfa, cactus, kodo, molasses grass, Paragua grass, wonder forage, zacate blanca de Honduras, millet, Sudan grass, sorghum, etc., have been acclimatized, besides various leguminous plants for forage purposes.

Propagation and distribution.—During the last five years, cuttings and rootstocks of various forage grasses valued approximately at ₱1,639.84 have been distributed to farmers as follows:

	CUTTINGS AND ROOTSTOCKS
1923	49,528
1924	102,034
1925	130,846
1926	30,000
1927	15,560
Total	327,968

OTHER CROPS PROJECT

Peanuts.—In a variety test of 12 varieties of peanuts carried on for five years, the Spanish, Tennessee Red, San Jose No. 3, and San Mateo gave the highest yields with 913.21, 905.56, 902.06, and 813.61 kilos of unshelled nuts, respectively, per hectare. The Spanish peanut gave the highest shelling percentage of 77 per cent. June was found the best month for planting the wet-season and October the dry-season crops.

Adlay.—In a variety test carried on for three years of fourteen varieties of adlay, the La Union Red topped the list with 711.23 kilos to the hectare, followed by the Mountain Province variety with 489.85 kilos. The best distance found for adlay is 80 by 50 centimeters apart with five plants to the hill.

Cowpeas.—The New Era cowpea has been found to be the best of the six varieties tested. Its yield of seed per hectare was 768 kilos with a cost of production of ₱48.30. When planted in the months of September, October, and November, the yields obtained were good. Plantings made in the months of May and June produced more vines than pods. At the end of one year seeds preserved in sawdust or garden soil gave a germination of 92 per cent while those kept in a glass bottle alone gave only 44 per cent.

Sorghum.—The yield of Basso sorghum was 1,187.5 kilos of clean grain per hectare, the cost of production of which was ₱54.40.

Wheat.—Eight varieties of wheat successfully headed but did not produce seeds except the Cagayan variety which yielded 1½ kilos of seed from a lot of 20.4 square meters.

Soybeans.—The Amis soybean gave the highest yield among the varieties tested, 491.16 to 1,219 kilos of seeds per hectare. The soybeans required shallower planting than the cowpeas in furrows not more than 2 or 3 centimeters deep.

Other miscellaneous crops such as the millet, gudo, etc., were successfully tried.

NOTES—SECOND QUARTER

A FREAK OF NATURE

By Eulogio B. Barrientos
Agricultural Extension Agent

"Like begets like" is an old principle, as old as science itself, by which the plant breeder, the amateur as well as the expert, is guided in the production of certain variations in plant life. A phenomenon, however, shows the exception to this principle. And we have one in the Province of Pangasinan in the form of a coconut tree with six branches—the subject of this paper.

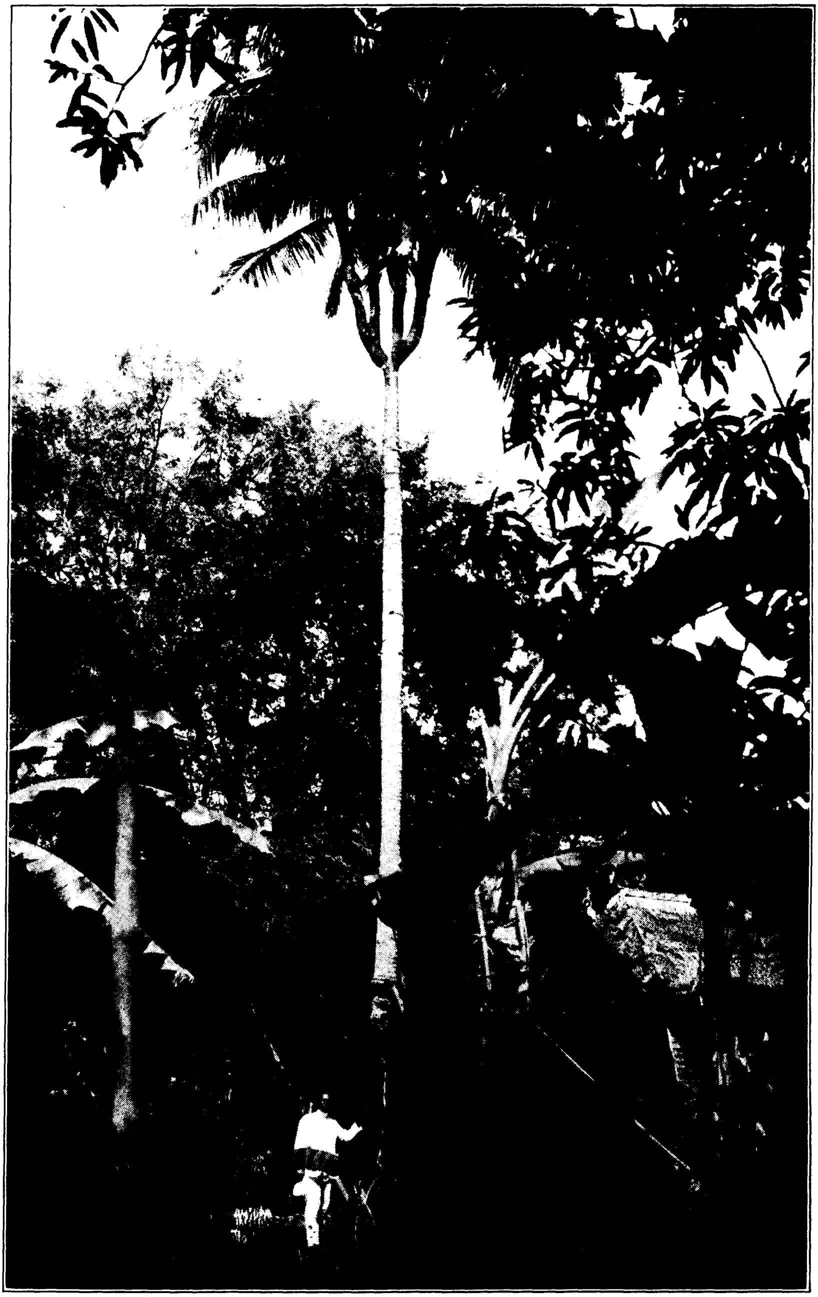
About six kilometers from the town on the right side of the Calasiao–Malasiqui road and in the barrio of Macabito, Calasiao, Pangasinan, there stands a stalwart coconut tree not less than 15 meters tall, with six branches. It is located in a conspicuous place between kilometer posts 5 and 6 about twenty meters from the road.

According to the present owners, a brother and a sister, the ownership of the tree has been handed down from generation to generation. The original planter, who was their grandfather and who died about 25 years ago, bequeathed the tree to his son, the father of the present owners, who died about six years ago. And by the death of the latter his children became the present owners of this tree.

The author cannot get any reliable account about the growth of the tree in view of the death of the planter and the second owner. However, an old timer who has been living in the place for about 40 years, gives the story that the seedling was planted when the Filipino Revolution was about to break out, or to be accurate, in about 1894. Special attention and care were given the tree during its growth, he added. The tree grew normally like any other coconut tree in the vicinity. The first nuts appeared about the time when a detachment of American soldiers arrived in Calasiao, according to the informant, or in about 1900, so that it may be said to have begun bearing fruits at the age of six years. According to our narrator the tree used to be very productive, its average production being not less than a hundred nuts of good size and quality per tree. This extraordinary average of fruiting continued for nine years, until a destructive typhoon passed through Pangasinan in October, 1909, stripping the tree of all its nuts, including the young ones. From that time the tree became a poor yielder. Three years later, what was the surprise of the owners when instead of buds that should have appeared from the crown, two branches grew! In 1913 the two branches bore fruits of regular size, and in 1915, or five years since the appearance of the two branches, two more secondary branches grew, one from each of the two branches, and in 1922 the last two branches or the secondary branches produced another two branches, so that this tree has now six branches.

The second owner made a good deal of money from the sale of nuts harvested from the tree and the present owners also find it a source of much profit. Some medicinal properties are attributed to the oil obtainable from the nuts of this tree by the people living in the neighborhood. The owners, aware of this belief, have taken advantage of it, and have sold nuts at ₱2 or sometimes for as high as ₱5 a nut, depending upon its size. Among the human ailments believed to be curable with the oil made out of the nuts of this tree are skin diseases, headaches, stomachaches, colds, and backaches.

The tree has become so well known to the people in the province that many excursionists, Filipinos and foreigners, come to the place to see it. And there is no excursion by public or private school students that does not include in its program a stop at this place to enable the students to see this freak of nature.



A branching coconut tree 15 meters tall, Calasiao, Pangasinan

FROM OUR CONTEMPORARIES

A farmers' coöperative organization in Belgium called the "Boerenbond" is generally credited with the change in status of the country from that of an importer of about three-fourths of its food to that of an exporter of eggs, milk, seeds, potatoes and vegetables. This association not only buys seeds, fertilizers and farm implements for its members but markets their farm products at a fair profit. A $2,000,000 building, the first skyscraper in Belgium, is being built by the Boerenbond at Antwerp.—*The Rice Journal.*

◆

Food iron should be present in pasture-plants in sufficient quantities for the animals eating them as a sole ration that they (the animals) may not die of iron starvation (bush sickness). The iron that is contained in the grass may be sufficient for its needs and yet not enough for the development of the rapidly-growing stock pastured thereon.

To correct this deficiency, iron medicinal salts in the form of licks, drench or pellets should be given or added to drinking water or milk. Pastures top-dressed with phosphates containing iron can carry stock much longer than those not so dressed. A mixture of equal parts of basic slag and superphosphate is the best for this purpose.

"Farmers in the pumice region are becoming more familiar with the practice of using the preparation known as citrate of ammonium and iron—the Ferri Ammon. Cit. of the druggist. This substance is supplied in the form of brown scales, which readily dissolve in water, and can then be sprinkled on dry rations in the bails for dairy cows, added to the milk food for calves, or mixed with molasses, salt or green bone, or a mixture of these, for store cattle."—*The New Zealand Journal of Agriculture.*

◆

"It is a debatable point whether the water requirements of cane can be wholly met by artificial irrigation. In the crops at the station, consisting of a very wide range of varieties and seedlings, the writer has frequently noticed an appreciable increase in growth immediately after a rain, though the crop has been receiving frequent irrigations all the time."

"* * * Rainfall, in addition to supplying moisture for cane growth, has the following other advantages over irrigation: (1) It has got a moderating influence on temperature and increases the moisture content of the air; (2) It helps growth by washing the lower surface of leaves, thus promoting free transpiration; (3) It washes out plant toxins and any harmful salts accumulated on the surface soil, as also egg masses of injurious insects deposited on leaves; and (4) It brings small quantities of nitrogen from the atmosphere."—*The Agricultural Journal of India.*

REVIEW

THE BREADFRUIT OF TAHITI. By Gerrit Parmile Wilder. Bernice P. Bishop Museum (Honolulu, Hawaii) Bulletin No. 50. 83 pp. 39 plates.

Tropical fruit enthusiasts, and breadfruit enthusiasts in particular, will welcome the publication of this bulletin as being not only the first publication containing detailed descriptions and illustrations of the breadfruit varieties of that island but from all the Pacific Archipelagos.

In the *Philippine Agricultural Review,* Vol. 17, pp. 24–39, 1924, Mr. P. J. Wester of the Philippine Bureau of Agriculture published a list of 189 variety names of the breadfruit that had appeared in various books, including a list of names furnished by Mr. Howard F. Whitey, American Consul in Tahiti. In addition Mr. Wilder in his descriptive list of 31 varieties includes no less than the 11 following new hitherto unrecorded varieties: Aata, Apuapua, Atiati, Havana, Harare, Hua papae, Marea, Matateoa, Piri ati, Rare aumee, and Vai paere. He lists the following new names of breadfruits with the remark that "Some of these names are applied to existing trees which are not sufficiently distinctive to constitute varieties, others undoubtedly refer to kinds of breadfruit which were known in olden days but which no longer grow:" Amae, Epea, Epiti, Epouhi, Evete, Erorua, Emouti, Fatai, Fafatea, Hamoa, Havae, Peetia, Pou marari, Putia, Poutia, Pouponou, Taupaitaa, Tautano, Uru moua, Upuupuu.

In connection with the large number of varieties enumerated by travelers, the following statement is of considerable interest: "A considerable number of (published) named varieties either do not exist today, except perhaps in isolated localities, and many varietal names are undoubtedly new names given to (recent) sports of well established varieties."

The descriptions of Mr. Wilder confirm the statements of earlier travelers in regard to the excellent quality of many varieties, but it would appear that others are of very little value from a culinary point of view. The large size some of these fruits attain, up to 30 centimeters long and 21 centimeters across, weighing 5 kilos each, will be a surprise to most readers who rarely see fruits even 2 kilos in weight.

The bulletin has 39 excellent plates.

It is to be hoped that this publication will be followed by others covering the rest of the Society Islands, the Marquesas, the Carolines, Fiji, and all other islands in the Pacific, and that plant material of all the good varieties will be obtained for propagation in Hawaii for eventual distribution to all parts of the Tropics.—P. J. W.

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Davao Plant Quarantine and Inspection Station, Davao:
T. VILLALON, Junior Plant Inspector, in Charge

Legaspi Plant Quarantine and Inspection Station, Albay:
V. OLAN, Junior Plant Inspector, in Charge

RESEARCH LABORATORIES

Pandacan Veterinary Research Laboratory, Manila:
Dr. E. A. RODIER, Veterinary Pathologist, in Charge

Pandacan Plant Pathology Laboratory, Manila:
Dr. N. G. TEODORO, Plant Pathologist, in Charge

Abaca Fiber Research Laboratory, Manila:
H. E. SHERMAN, Chemist, in Charge

Singalong Entomology Laboratory, Manila:
F. Q. OTANES, Entomologist and Assistant Chief, Plant Pests Control Division, in Charge

Alabang Insect Pests Laboratory, Rizal:
S. S. GONZALES, Scientific Assistant, Acting in Charge

La Carlota Sugar Laboratory, Occidental Negros:
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